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ABSTRACT

Presented is a case study of a college program focused upon the application of science and technology to development in less developed countries. The activities described are those of the University of Hawaii's College of Tropical Agriculture. This program's history, components, problems, and future prospects are discussed in an attempt to learn effective approaches that the United States can follow in offering technical assistance to developing nations. (WB)

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Denver Research Inst, CO

Prepared for

National Science Foundation, Washington, DC

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REPORT

A CASE STUDY IN THE U.S. APPLICATION OF SCIENCE AND TECHNOLOGY TO DEVELOPMENT IN DEVELOPING COUNTRIES

JUNE 1978

UNIVERSITY OF DENVER • DENVER RESEARCH INSTITUTE
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16. Abstracts

The purpose of this study is to illustrate and gain inslight into the development and evolution of Less Developed Countries-oriented, scientific and technological activities at the College of Tropical Agriculture, University of Hawaii; to discuss their problems and future outlook; to attempt to learn from their experience in seeing how the United States can practically assist in apply science and technology to development in developing countries.

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The College of Tropical Agriculture at the University of Hawaii: A Case Study in the U. S. Application of Science and Technology to Development in Developing Countries

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Washington, D. C.

August 1978

Any opinions, findings, conclusions, or recommendations expressed in this report are those of the author and do not necessarily reflect the views of either the University of Hawaii or the National Science Foundation.

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Executive Summary

In August of 1979, the United Nations will be holding a Conference on Science and Technology for Development (UNCSTD) in Vienna, Austria. This conference embodies an effort on the part of the United Nations to draw together the scientific and technological (S&T) potential of the developed countries so as to benefit the developing world. The principal mechanism of this effort is the process of preparation of national or country papers by all nations, in which the developed countries are to examine their own experience/performance and potential for applying science and technology to development and transferring technology to the less developed countries (LDCs).

The United States is attempting to respond constructively to requests put forward by the LDCs, and, as one of the most technologically advanced nations in the world, it is trying to make a positive and realistic contribution to this Conference. As part of the United States effort to prepare for this Conference, the Science Resource Studies Division of the National Science Foundation awarded a grant to the University of Denver Research Institute to test the feasibility of developing an operational methodology for the generation of quantitative estimates and descriptions of U.S. expenditures for S&T activities oriented towards the developing countries, and to collect and present such data in a form that could be utilized in the preparation of the U.S. national paper. In addition to strictly quantitative data and brief descriptions, however, it was thought that a "case study" might also be useful for this preparation--that a case study could illustrate what numbers alone cannot; just what a specific LDC-oriented S&T program is, what it is composed of, what its problems have been, what its future outlook is, how it has developed and evolved.

A case study does not necessarily have to be representative--it can be designed to achieve a specific purpose. In this case, the purpose of this study is to illustrate and gain insight into the development and evolution of LDC-oriented, S&T activities at the College of Tropical Agriculture (CTA), University of Hawaii; to discuss their problems and future outlook; to attempt to learn from their experience in seeing how the U.S. can practically assist in applying S&T to development in developing countries.

In the sections of this case study which follow, the University of Hawaii is first of all in Section II placed into the context of the land grant university system which exists in the U.S. Recent legislative developments which have and are currently influencing CTA's LDC-oriented S&T activities are then discussed in Section III. These include Section 406 of the Food for Peace Act of 1966, Title XII of the International Development and Food Assistance Act of 1975, and Section 1458 of the Omnibus Farm Bill of 1977. In Section IV, the major events which have occurred in the history and evolution of CTA are discussed, particularly as they relate to the creation and development of international S&T activities. Descriptions of the major CTA activities--education, research, information, and extension--occur in Section V, again with an emphasis on the international aspect. The major problems and issues which CTA has faced in its attempts to apply S&T in LDCs are then discussed in Section VI, and what the future may hold for CTA in Section VII.

There are many more implications which arise from the CTA case study than can be accommodated in this brief summary. Certainly it can be said, however, that starting up and maintaining a program for the application of science and technology in developing countries is not an easy thing to do--it is a continual effort with many failures and frustrations along the way. As always, a small group of individuals appear to lead the way, to persist in this effort--international agricultural "champions" they might be called--while the majority lag behind or are simply not interested. "Politics" has been an important ingredient to this history at federal, state, and university levels. There do seem to be major, key events which have occurred along the way and which have greatly influenced subsequent development and evolution of the institution. And, despite all the problems, success is possible.

I. Introduction

In August of 1979, the United Nations will be holding a Conference on Science and Technology for Development (UNCSTD) in Vienna, Austria. This conference embodies an effort on the part of the United Nations to draw together the scientific and technological (S&T) potential of the developed countries so as to benefit the developing world. The origins of UNCSTD relate back to the disappointment over the perceived lack of concrete action that had followed the 1963 U.N. Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas.

The principal focus of UNCSTD is the application of science and technology to development:

> The main purpose of the Conference is not to discuss science and technology as such but the whole complex of policy considerations concerned with the accelerated application of science and technology to development at the national level and with increased international cooperation.[1]

The principal vehicle through which this discussion is to take place is the process of preparation of national or country papers by all nations.[2] In these papers, the developed countries are to examine their experience/performance and potential for applying science and technology to development and transferring technology to the less developed countries (LDCs), identifying and clarifying means/mechanisms and constraints/barriers. As such, preparing national papers should be an educational experience for both developed and developing countries in which the process of preparation may be as important--if not more so--than the final paper product.

The United States is attempting to respond constructively to requests put forward by the LDCs, and, as one of the most technologically advanced nations in the world, it is trying to make a positive and realistic contribution to this Conference. As Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs Patsy T. Mink has stated in a recent speech to the National Science Board:

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[1] UNCSTD, "Guidelines for the Preparation of National Papers" A/CONF.81/INF.1, 7 March 1977, p. 14.

[2] "The Process of their preparation is to be the essential instrument of the Conference in bringing about the strengthening of national capabilities for the application of science and technology to achieve the degree of national self-reliance called for in the new international economic order." ("Guidelines for the Preparation of National Papers, p. 4").

> It is essential for the United States to be an active participant and contributor to the conference. . .The U.N. Conference on Science and Technology must be seen as a mechanism for easing tensions between the nations of the world. We must take advantage of the opportunities being offered by this conference.[3]

As part of the United States effort to prepare for this Conference, the Science Resource Studies Division of the National Science Foundation awarded a grant to the University of Denver Research Institute to test the feasibility of developing an operational methodology for the generation of quantitative estimates and descriptions of U.S. expenditures for S&T activities oriented towards the developing countries, and to collect and present such data in a form that could be utilized in the preparation of the U.S. national paper. In addition to strictly quantitative data and brief descriptions, however, it was thought that a "case study" might also be useful for this preparation--that a case study could illustrate what numbers alone cannot; just what a specific LDC-oriented S&T program is, what it is composed of, what its problems have been, what its future outlook is, how it has developed and evolved.

A case study does not necessarily have to be representative--it can be designed to achieve a specific purpose. In this case, the purpose of this study is to illustrate and gain insight into the development and evolution of LDC-oriented S&T activities at the College of Tropical Agriculture (CTA), University of Hawaii; to discuss their problems and future outlook; to attempt to learn from their experience in seeing how the U.S. can practically assist in applying S&T to development in developing countries.

The CTA was chosen as the subject of the case study for several reasons:

- It is one of the few places in the U.S. which is located in a tropical environment. Therefore, any S&T activities oriented towards the LDCs should have less of a temperate zone environment handicap;

- It is not an AID program, although AID has funded specific S&T activities and has been a significant actor in the development and evolution of CTA. AID programs are unique in the government in that AID's specific mission is to assist in the development process in LDCs. The remainder of the Government (e.g., USDA, DOC, DOE, HEW, NSF, etc.) largely is oriented towards domestic missions, and S&T activities oriented towards the LDCs are much more difficult to justify;

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[3] Patsy T. Mink, "Science and Its Interrelationships with Foreign Policy," speech before the National Science Board of the National Science Foundation, 16 September 1977.

- At the same time, there is some specific legislative authority (Section 406--to be subsequently discussed) for CTA to engage in S&T activities for the LDCs;

- Agriculture--Food is one of the subject areas selected by UNCSTD for discussion at the Conference, and is a field that may well assume great importance in discussions of the application of S&T to development;

- Not only is R&D included in the CTA's activities, but also an innovative scientific and technical information (STI) program for tropical agriculture, plus educational and extension activities. Therefore, a variety of S&T activities can be examined in one program case study; and

- Finally, there was an element of convenience involved in that the author could stop by Hawaii on returning from other business trips to the Far East at very little cost to the National Science Foundation.

Therefore, in late November 1977, the author paid a visit to CTA and interviewed several key people and collected written materials relevant to the case study. During the ensuing months, a draft case study was written and subsequently discussed and revised with CTA faculty on a return visit in early June 1978. Thus, this case study is not based on original research done on site, but on the memories and opinions of people and on secondary source material. Several people must be thanked for their assistance and cooperation: Dr. William Furtick, Dean of the College of Tropical Agriculture; Dr. Kenneth Otagaki, Director of International Agricultural Programs in CTA; and faculty members Dr. Peairs Wilson, Dr. Donald Plucknett, Dr. Peter Rotar, Dr. Walter Sanford, Dr. Goro Vehara, and Mrs. Barbara Bird.

II. The University of Hawaii--A Land Grant University

The University of Hawaii today is a multi-campus system of higher education which serves the State of Hawaii. It was founded in 1907 as a land grant college of agriculture and mechanical arts called the College of Hawaii. In 1920, the College of Arts and Sciences was added and it became the University of Hawaii. Today there are seven academic colleges. In addition to Tropical Agriculture and Arts and Sciences, there are Business Administration, Continuing Education and Community Service, Education, Engineering, and Health Sciences and Social Welfare. The University currently offers bachelor's degrees in 74 programs, master's degrees in 63, and doctorate's in 31. Total enrollment on all campuses is about 40,000, with approximately 21,000 students on the main campus at Manoa.

Notwithstanding its growth and changing character, however, the University of Hawaii remains a land grant university, and a brief description and history of land grant institutions may be useful at this point. The United States Department of Agriculture (USDA) was created by legislation signed by President Abraham Lincoln on 15 May 1862.[4] Less than two months later, the Morrill Act was enacted by Congress which provided that portions of federally owned land be sold to finance the perpetual endowment in each state of at least one college whose main aim would be to teach branches of learning related to agriculture and the mechanical arts.[5]

The existence of the land grant colleges provided the setting for the realization that only limited knowledge existed of U.S. agriculture and its problems and of the potential for the application of science and technology through research. As a result, the Hatch Act was enacted by Congress on 2 March 1887, which provided federal funds ($15,000 to each state) for the establishment of State Agricultural Experiment Stations (SAES) in each state--most of which developed as part of the land grant colleges/universities. A series of legislative acts provided further federal funding and emphasized different aspects of research,[6] but essentially this institutional innovation has continued to the present. Today there are 55 SAESs--48 states, Puerto Rico, Guam, and the Virgin Islands have one each, and two states have two each.

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[4]Prior to this time, the Patent Office had been responsible for federal agriculture activities.

[5]See USDA, After a Hundred Years: The Yearbook of Agriculture, 1962, Washington, D.C., 1962, p. 13

[6]A second Morrill Act in 1890 authorized the establishment of Negro land grant colleges; the Adams Act of 1906 supplemented the Hatch Act, emphasized basic research, and granted an additional $15,000 to each state; the Purnell Act of 1926 again supplemented the Hatch Act, emphasizing agricultural economics and providing an additional $60,000 to each state; the Bankhead-Jones Act of 1935 fixed the flat amount to each state under the Hatch Act at $90,000, but initiated further formula funding based on rural population--and emphasized conservation and the utilization of agricultural products; a Research and Marketing Act of 1946 supplemented the formula funding and emphasized marketing; a Hatch Act Amendment of 1955 which incorporated the previous acts into one funding system; and into the 1960's when several new legislative initiatives were made but not fully funded. (8 November 1977 memo from Peairs Wilson to Dean William Furtick, "An Analysis of PL95-113, The Omnibus Farm Bill.")

The SAESs are the primary agricultural research organizations of the different states, and their research programs are under state control. However, they do receive funding through USDA's Cooperative State Research Service (CSRS), which amounts to around $100 million annually and accounts for about 20% of SAES research programs.[7] CSRS is also responsible for reviewing and coordinating the research which individual SAESs propose to undertake.

The third major component of the land grant university system--the Cooperative Extension Service--was established under provisions of the Smith-Lever Act of 8 May 1914 to fill the information gaps between USDA, land grant universities, and SAESs, and farmers. Extension is a cooperative effort between USDA, the states (through the land grant universities), and county governments. The administration of extension programs in each state is the responsibility of a State Director of Cooperative Extension Service, who is employed by the land grant university and is responsible to the administrative head of the College of Agriculture at that university. The USDA Director of Federal Extension Service provides national leadership and coordination among the states. The county extension agents have traditionally been the key people in this system who actually transfer technology to the farmer.

This system is complex and geographically decentralized. It is, perhaps, difficult to understand and manage, but it does--according to its proponents--have the merit of a built-in responsiveness to a wide range of local problems and conditions.

The typical College of Agriculture at a land grant university thus embraces three interrelated functions: education, research, and extension. This interrelationship occurs most fundamentally at the individual level--faculty and staff members are often involved in at least two of the three functions; graduate students in both education and research functions. Once again, proponents of the system believe that these interrelationships are the key to its strength:

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[7] SAESs also receive funding from their respective states, from private industry, foundations, etc. Directory of Federal Technology Transfer, Federal Council for Science and Technology, Washington, D.C., June 1976, p. 3.

> These research - extension - graduate instruction interrelationships are a fundamental strength of the Nation's agricultural research system. From a functional viewpoint, the lines which separate the various roles are subordinated to the ultimate goal of solving problems and training future scientists and agricultural leaders.
>
> The relationship between land grant universities, State experiment stations and USDA represents a unique and potent force for compiling scientific knowledge and getting it into the hands of the people for intelligent action on their own behalf [8]

The U.S. Agricultural research and extension system, with state land grant universities as one of the primary components, is perhaps one of the world's best known models for developing and transferring new technology to a society. This model has been referred to and copied--mostly in part, rather than in its entirety--with differing degrees of success or failure in many LDCs. Whether and in what ways this system has been all that successful, however, depends on what questions are asked, and what criteria accomplishments are measured against. Most statements of certainty about the utility of the system merely offer the accomplishments of the U.S. farmer in terms of labor productivity as proof. For example:

> There is overwhelming proof that the USDA - State Agricultural research and extension system works. The remarkable efficiency of American agricultural producers attests to the success of the system . . .[9]

Others have differing assessments of the value of some of these accomplishments, however, and no cause-and-effect relationship is established--it is merely assumed.[10]

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[8] Dean Orville Bently testimony, "Publicly-Supported Agricultural Research and Development and Agricultural Technology Transfer in the United States," USDA, Washington, D.C., October 1975, p. 13.

[9] Testimony by Robert W. Long, reprinted in "Publicly-Supported Agriculture Research and Development," op. cit., pp. 4-5. He goes on to mention such things as, "In the past 5 years, farm production per man-hour has doubled...One hour's farm labor now produces 8 times more than it did in 1921..."etc.

[10] Thus, no one asks the question if the productivity accomplishments of the U.S. farmer might not have been just as great--or even greater--in the absence of the research-extension system. Undoubtedly, there is some justification of such an assumption, but research is only one among many factors--e.g., capital investment--that have contributed to the performance of U.S. farmers.

Indeed, figures that indicate efficiency and labor productivity do not tell the entire story. Since 1940, some 30 million people in the U.S. have left the rural countryside for urban, industrial areas, and some 800,000 people per year continue to do so. Two thousand farming units go out of business each week, and over half of those which are left produce less than $5,000 of sales per year. Fourteen million rural Americans live below the poverty line. These conditions have been costly in terms of social welfare, and have been caused--at least in part--by changes which have resulted from the generation and extension of new technology through land grant universities; technology that has operated in favor of agri-business and the larger, more progressive farmer.[11]

Further criticism of the research-extension system and land grant universities has been expressed with regard to the scientific quality of the work performed. A report prepared by a committee of the National Academy of Sciences and chaired by Dr. Glenn S. Pound, Dean of the College of Agriculture and Life Sciences at the University of Wisconsin[12] claims that this system is badly managed, low quality and highly politicized. According to Wade, this report:

> ...faults the quality of agriculture research right across the board, ranging from poor administrative leadership in the USDA, to misallocation of resources for research, neglect of basic sciences, and the low quality of science and scientists both in the USDA and at state supported research institutes.[13]

Most of the principal reasons for this state of affairs--again, according to Wade--are political. Both federal and state agricultural research and extension are fragmented into many small units across the country, often inefficient and duplicative, as the personal prerogatives of politicians.

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[11] Nicholas Wade, "Agriculture: Social Sciences Oppressed and Poverty Stricken," Science, Vol. 180, 18 May 1973, p. 719.

[12] The NAS convened this 19-member committee in 1969 at the request of Secretary of Agriculture, Clifford M. Hardin. The committee submitted a report entitled "Report of the Committee on Research Advisory to the USDA" to USDA in 1972.

[13] Nicholas Wade, "Agriculture: NAS Panel Charges Inept Management, Poor Research," Science, Vol. 179, 5 January 1973, p. 45. Quoting from the Pound report, Wade further cites the following: "...much of agricultural research is outmoded, pedestrian, and inefficient...an unwarranted duplication of effort ..an inexcusable amount of mediocre and duplicative research...far too much of the research is of low scientific quality...in the area of management of scientists, the committee found very disturbing evidence of ineptness with direct impact on research quality...Admittedly, quality is a judgement factor, but the regularity with which the committee came up with judgements of low quality, including both USDA and SAES research, is significant and appalling..."

The SAESs have considerable influence in Washington, both through their congressmen and their lobbying organization--the National Association of State Universities and Land Grant Colleges--and they often compete rather than cooperate with USDA for resources. Cooperation among the SAESs on other matters, such as research planning, is also lacking as each SAES jealously guards its own autonomy and competes with other SAESs for resources. Supposedly, SAES directors plan and coordinate their research through the Experiment Station Committee on Organization and Policy (ESCOP), but Wade feels that this is, in reality, just another lobbying organization with little influence over individual states. A similar lack of influence is exhibited by USDA's Cooperative State Research Service in reviewing and coordinating SAES projects and programs. The most recent organizational entity created to harmonize public supported agriculture research, the Agricultural Research Policy Advising Committee (ARPAC), suffers from the same fault:

> ESCOP, ARPAC, CSRS, the National Planning Staff, the Program Analysis Coordination Staff, the regional planning system--the common feature of these bodies is that their powers are considerably less grand than their titles. They are the window dressing on the political realities, producing for both public and internal consumption a geocentric explanation of a heliocentric system.[14]

This, then, comprises some of the history and complexities and ambiguities of state land grant universities, one of which is the University of Hawaii.

III. Recent Legislative Developments

In addition to the previous brief history and description of land grant universities, three recent pieces of legislation are important to the development and evolution of CTA: Section 406 of the Food for Peace Act of 1966; the Title XII Amendment to the International Development Food Assistance Act of 1975; and the Omnibus Farm Bill of 1977, particularly Section 1458. These are briefly described below.

Section 406. In 1966, then Congressman Spark Matsunaga from Hawaii was instrumental in sponsoring an amendment to the Food for Peace Act which, in his own words:

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[14] Nicholas Wade, "Agriculture: Research Planning Paralyzed by Pork-Barrel Politics," Science, Vol. 180, 1 June 1973, p. 936.

> ...provided for research in tropical and subtropical agriculture for the improvement and development of tropical and subtropical food products for dissemination and cultivation in friendly (developing) countries.[15]

This amendment became Section 406 of the Food for Peace Act of 1966, and it authorized the expenditure of up to $33 million per year for this purpose, to be administered by USDA. As expressed in a recent proposal by the Universities of Hawaii, Puerto Rico, and Florida, the intent of Section 406:

> ...was to develop U.S. indigenous capacity in the technologies and techniques of tropical food production and consumption. This expertise could then be made available to developing countries, thereby reducing the need for deficit food assistance and making more efficient use of agricultural aid supplied by the United States.[16]

For a number of years after the passage of Section 406, however, no implementation of tropical agricultural research occurred because, in Matsunaga's view, of a lack of interest on the part of USDA. In 1971, a USDA task force suggested that $20 million be appropriated to establish research centers under Section 406, but the Office of Management and Budget (OMB) did not include this recommendation in its FY73 budget. A USDA study on implementing Section 406 in 1972-73 recommended tropical agricultural research centers in Hawaii and Puerto Rico, with the special skills and expertise of other institutions being involved through these programs. Congress did appropriate $3.8 million for this purpose in its FY73 Agricultural Appropriations Bill, and USDA did propose $500,000 for the start-up of these centers, but the funds were impounded by the Nixon administration. One year later, however, funds were appropriated and allocated again, and this time--in August 1974--USDA granted the University of Hawaii $230,000 to undertake program planning and technology assessments for developing a tropical agricultural research center. Similar grants were subsequently awarded to universities in Puerto Rico, Florida, and California.[17]

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[15] The Honorable Spark Matsunaga, "Meeting the World Food Crisis through American Tropical Agricultural Research," HortScience, Vol. II(3), June 1976, p. 181. The actual wording of Section 406 is as follows: "a) In order to further assist friendly developing countries to become self-sufficient in food production, the Secretary of Agriculture is authorized, notwithstanding any other provision of law...4) To conduct research in tropical and subtropical agriculture for the improvement and development of tropical and subtropical food products for dissemination and cultivation in friendly countries." Other parts of Section 406 called for a farmer-to-farmer assistance program, the training of personnel in the techniques of transmitting improved practices in agriculture to developing country farmers, etc.

[16] Universities of Hawaii, Puerto Rico, Florida, "A Proposal to Expand the Implementation of the Tropical Food and Agriculture Research Provisions of Section 406, Public Law 89-808," 17 February 1978, p. 2.

[17] "Meeting the World Food Crisis," p. 181.

Funding under Section 406 since 1974 has remained at "token" levels, however. Annual budget expenditures have varied between $500,000 and $672,000, and the total in the five years from 1974 through 1978 has been only $2,878,000.[18] In view of this low level of funding, the work has been conducted on a project-by-project rather than a programmatic basis, with about half of the projects conducted in-house at USDA laboratories and the other half funded as extramural contract research to land grant universities. Most of the projects have been in crop production research (e.g., disease-resistant varieties of tropical beans and cowpeas, virus resistant papayas, production and handling of root crops, etc.). Under Section 406 funding, no work to date has actually been done in LDCs.[19]

The future of Section 406 would appear to be somewhat ambiguous. Matsunaga is optimistic, feeling confident:

> ...we can expect to see these grants continue and their amounts to grow, enabling the development of major tropical agricultural research centers in the United States.[20]

The Universities of Hawaii, Puerto Rico, and Florida, in their proposal to expand the implementation of Section 406, point out that the reasons which led to its original passage in 1966 have become even more compelling in the intervening years. Still, the initial request of USDA for Section 406 funding of $2.1 million for FY79 was reduced to only $450,000![21] The above universities have submitted substantially expanded plans and budgets to Congress, however, and requests for add-on appropriations for FY79 have been introduced in both the House and Senate.

Title XII: During the United Nations World Food Conference in Rome in 1974, the United States pledged to share its agricultural technology with the LDCs in order to help solve the world food problems. As a result of this pledge, a bipartisan amendment to the International Development and Food Assistance Act of 1975, known as Title XII, was passed with a wide majority. Entitled "Famine Prevention and Freedom from Hunger," Title XII:

> ...is designed to enlist fuller and more effective use of one of America's great resources - its land grant and similar agricultural colleges and universities - in meeting the challenge of increasing food supplies for the growing population of developing countries...

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[18] USDA, "Tropical and Subtropical Agricultural Research," no date.

[19] Ibid.

[20] "Meeting the World Food Crisis," p. 181.

[21] "Tropical and Subtropical Agricultural Researc

> The new Title XII thus seeks, through Foreign Assistance Act funding, to strengthen the capabilities of land grant and similar U.S. universities to help improve farm production in developing countries. It will promote the building of agricultural institutions and programs in poor countries which foster research and teaching and conveying agricultural information directly to farmers in the field. It will support long-term collaborative university research and the international agricultural research centers and specific research projects, and involve universities more fully in the international network of agricultural science. And it will accord a stronger statutory role to the U.S. universities in assisting the Agency for International Development in these programs.[22]

Many people perceive Title XII to be a great opportunity:

> An opportunity now exists under Title XII to program, in participation with other Federal and international agencies as well as U.S. universities, activities relating to famine prevention and freedom from hunger over a 5-year period. This opportunity, if exercised in a spirit of a truly cooperative effort, could unite the vast expertise in agricultural research, teaching, and development which exists in the land grant universities and the United States Department of Agriculture (USDA) with the implementing authority and logistical support of USAID to interact with the international agricultural research centers and the national institutions in developing nations where USAID programs exist.[23]

> This amendment..in essence proposed a fourth dimension to the agricultural land grant universities...This fourth dimension would give these universities resources to help transfer technology to the developing countries and at the same time increase their research and development capacity to ensure that the U.S. maintained its food production for export...This act has far-reaching significance to Hawaii...[24]

A Board for International Agricultural Development has been created to assist USAID in the administration of Title XII and to be the focal point for the increased U.S. university role in foreign assistance. A Joint Research Committee and a Joint Committee on Country Programs are also provided for under Title XII to serve under this Board. No new funds were authorized for Title XII; however, funds under Section 103 on Food and Nutrition were to be used for this

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[22] "International Development and Food Assistance Act of 1975," Report of the Committee on International Relations, U.S. House of Representatives, 1 August 1975, p. 25.

[23] Edwin B. Oyer, et al, "Potential Increases in Food Supply Through Research in Agriculture - Constraints in Increasing Agricultural Production in the Tropics: Research and Implementation Needs," prepared for the National Science Foundation, New York State College of Agriculture and Life Sciences, 1976, pp. 13-14.

[24] William R. Furtick, "The Role of U.S. Agriculture in International Development," in the "Proceedings: First Annual Pan Pacific Agricultural Conference," held in Honolulu, Hawaii, 5-7 July 1977, p. 58.

purpose, with certain funding restrictions removed. In order to stress the need for long-term commitments under Title XII, and to encourage additional support from the university community and others, the three-year funding limitation for university grants was also removed.

This aspect, i.e., the diversion of funds rather than additional funds, suggests that the implementation of Title XII may also be slow. Indeed, Congress apparently expected action under Title XII to be rather slow in starting:

> However, the initial Title XII expenditures are expected to be relatively small, and to increase rather slowly, because of the gradual nature of the institution-building process.[25]

The Omnibus Farm Bill of 1977. The Omnibus Farm Bill of 1977 PL 95-113, signed into law on 29 September 1977, has been termed "landmark legislation." Although there does, indeed, appear to be something for everybody, the most relevant part of it from the viewpoint of land grant universities and the LDCs is Section 1458:

> Sec. 1458. The secretary, subject to such coordination with other Federal officials, departments, and agencies as the President may direct, is authorized to:
>
> (1) expand the operational coordination of the Department of Agriculture with institutions and other persons throughout the world performing agricultural research and extension activities by exchanging research materials and results with such institutions or persons and by conducting with such institutions or persons, joint or coordinated research and extension on problems of significance to agriculture in the United States;
>
> (2) to assist the Agency for International Development with agricultural research and extension programs in developing countries;
>
> (3) to work with developing countries on agricultural research and extension including the stationing of United States scientists at national and international institutions in such countries;
>
> (4) assist United States colleges and universities in strengthening their capabilities for agricultural research and extension relevant to agricultural development activities overseas, and
>
> (5) further develop within the Department of Agriculture highly qualified experienced scientists who specialize in international programs, or to be available for the activities described in this section.

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[25] "International Development and Food Assistance Act of 1975," p. 26.

What this section will mean in practice is yet open to debate, of course. PL95-113 was authorizing legislation only--no appropriations were involved. In their proposal to expand Section 406 programs, the Universities of Hawaii, Puerto Rico, and Florida claim that Section 1458 will provide support for scientists not directly involved in Section 406 programs to participate in them:

> The Farm Bill, through Section 1458, can provide support by giving universities at other U.S. institutions direct access to the Section 406 research programs. Such collaboration will assist in identifying key tropical agricultural research and development problems, in designing and investigating appropriate agricultural technology, in developing social systems models to insure effective communications, and in testing and disseminating research results. Section 1458 can be used for travel, consultation, training programs, and short cases.[26]

In summing up this section of the case study, it is probably fair to say that both Congress and the Executive Branch have been willing to make fairly extensive legislative commitments to significantly expanding the scientific and technical role of the U.S. land grant universities in developing countries. The legislative mandate exists. Up to the present time, however, the allocation of resources to back up those commitments has not been made.

IV. Major Events in the Evolution of the College of Tropical Agriculture

The origins of the College of Tropical Agriculture go back to the turn of the century when USDA established some experiment stations in the territory of Hawaii. As stated earlier, the University of Hawaii began as a land grant college of agriculture and mechanical arts--the College of Hawaii--in 1907, becoming the University of Hawaii in 1919. Although these origins seem long ago, they are still reflected today. One of the first heads of the experiment station was a soil scientist who was naturally interested in promoting his particular field, and tropical soils today is one of the very strong scientific areas in CTA.

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[26] "A Proposal to Expand the Implementation of ....Section 406," pp. 4-5.

No particular major events relating to utilizing the scientific and technical capabilities of CTA in or for the LDCs appear to have occurred until the early 1960's. In 1960, the East-West Center was established[27] which added an international dimension to the entire University. The East-West Center does not offer degrees, credits, or courses, but it does bring Asian-Pacific students to the University of Hawaii where they then take courses in degree programs. Beginning at this time, CTA began to enroll many more LDC students. Moreover, agriculture and food were considered important issues at the East-West Center, and by 1965 almost half of their students were taking their degree programs at CTA. (This has since declined to 25-30% at present. In addition, the total number of students at the East-West Center has also declined.) This brought about a change in CTA curriculum which became more oriented towards the LDCs, and a definite commitment to the LDCs began to grow on campus. The East-West Center was also well funded, and was able to operate internationally, i.e., to hold conferences on campus with invited LDC guests and to get people together.

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[27] The East-West Center, established in Hawaii by the United States Congress in 1960, is a national educational institution with multinational programs. Its basic purpose is to promote better relations and understanding among the nations and peoples of Asia, the Pacific area, and the United States through cooperative participation in the design, conduct, and evaluation of the center's research, study, and training activities... Each year about 1,500 scholars, leaders, public officials, professionals, and graduate students come to the Center from the U.S. and more than 60 countries and territories, ranging from Korea to Iran on the Asian continent and from Japan to Australia to Easter Island in the Pacific. For each participant selected from the U.S. two are selected from the Asia-Pacific area. For all projects and activities, breadth of geographical and cultural participation is sought... The center is located in Honolulu and is administered by a public, educational, nonprofit corporation with an autonomous board of governors, composed of distinguished Americans, Asians, and Pacific islanders. The Center maintains close and cooperative relationships with the University of Hawaii and has access to University degree programs, libraries, computer center, and athletic facilities, under specified conditions... Programs are conducted within five problem-oriented institutes. Contents of these programs involve problems which significantly affect relations and understanding among countries East and West. Since 1970, the Center has conducted programs in communication, culture learning, food, population, and technology and development. Near the end of 1977, the programs on food and technology and development will join forces on the broader problem of the interconnection of resource systems. A new program on transnational problems of environment and policy will begin... The Center is a "learning" institution rather than a "teaching" one in that it offers no degrees, credits, courses, or grades. Projects enable participants and staff to cooperate in developing new knowledge useful for policy making and in production, sharing, and testing of policy aids, curricula and instructional materials for schools, universities, and in-service training of leaders in education, government, and businesses... East-West Resource Systems Institute. In this new institute, previous work on the resources of food technology will

In 1961, USAID awarded CTA a contract to work with Kasetsart University in Thailand in building up its agricultural educational and research capabilities. This appears to have been CTA's first LDC project, and it set in motion future attempts to engage in international activities. About 10-15 CTA faculty and several graduate students spent varying periods of time in Thailand working on this project, totaling 20 man-years of effort over a four-year period. Most importantly, this contract gave CTA some travel flexibility and experience in LDCs--they "got their feet wet" so to speak. The total value of this contract was $867,000 over four years.

Around 1964-65, certain people in CTA began to realize the potential that existed for tropical agriculture work related to LDCs. One informant mentions 1964 as the time when changes began to appear in the CTA, when a group was formed to work on long-term planning for what the University ought to be doing in international agriculture; another mentions 1965 when a CTA meeting was held on starting up international activities as the time when things began to happen. Section 406 legislation in 1966 was apparently at least partially a product of these planning activities.

But many things happened around this period of time with a new University administration and the beginning of a larger and more broadly-based University as a whole. What is important is that the interest and awareness in tropical agriculture and the LDCs began to grow as the opportunity was recognized. Hawaii does, after all, have the obvious advantage of being in a tropical climate, with tropical soils and vegetation. Hawaii was developed on the basis of plantation agriculture or commercial agri-business--pineapples and sugar cane--but has a large number of local small farmers existing side-by-side--the classic dual modern vs. traditional agricultural economy. Hawaii thus has many of the same problems that LDCs do. For example, as agriculture mechanization technology was

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be carried on, but within a broader scope in which additional resources are also examined as part of an overall program on resource systems, their interconnections, and their relationships to problems of unequal distribution and consumption. Projects which continue from the former institutes on food and technology and development are (new projects specifically related to "Resource Systems" have not yet been developed): "Living Aquatic Resources Management," "Pest Management," "Increasing Productivity Under Tight Supplies," "Technology Assessment," "Renewable Resources Planning and Development," and "Public Policy Implementation and Project Management."

("1977-1979 Graduate Information Bullentin," University of Hawaii, pp. 11-12.)

developed and applied, many of the plantation farm workers were displaced with an inadequate industrial base to absorb them. From its origins, the CTA experiment station was directed to work on the problems of small farmers —diversified agriculture on marginal lands--rather than pineapples and sugar cane, which was left to the plantations. What was formerly regarded as a limiting constraint upon the CTA, however, can now be seen as an important potential opportunity with respect to the LDCs![28] Much of the CTA faculty and staff, who arrived before the mid-1960's, brought with them an interest in international agriculture that could be excited by the potential opportunity.

In 1965, Dr. C. Peairs Wilson arrived from Kansas to become Dean of the College of Tropical Agriculture. As he states it, he came to the University of Hawaii particularly because of his interest in tropical agriculture and LDCs. He knew that the mainland U. S. was not suited to this purpose, and he foresaw Hawaii as a center for the conduct of tropical agricultural research and the extension of agricultural assistance to LDCs--where the real problems were. Back in Kansas, Dr. Wilson had discussed this interest with then-Congressman Robert Dole, and it is no accident that both he and then-Hawaii Congressman Spark Matsunaga were instrumental in writing the legislation which became Section 406 in 1966.

As has been indicated earlier, however, the passage of Section 406 did not immediately have any impact upon CTA. Wilson and others tried to get interest stirred up in Washington, in both USDA and USAID, but were met mostly with indifference. Secretary of Agriculture Orville Freeman put appropriations for Section 406 into the last budget of the Johnson administration, but after the election of Nixon, this aspect of USDA activities was scratched by Secretaries of Agriculture Clifford Hardin and, later, Earl Butz. Finally, after some political pressure, particularly from Hawaii Republican Senator Hiram Fong, small amounts of funding for Section 406 made it through USDA and the OMB in the early 1970's.

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[28] And not only in the LDCs. The CTA also raises this aspect of its capabilities with respect to the small black and Chicano farmers in the Southern United States.

In the meantime, a non-degree training program in tropical crops production was started on the island of Kauai in 1967 by Professor Donald Plucknett of CTA. At that particular time, the International Rice Research Institute (IRRI) in the Philippines was being overwhelmed with requests for training in rice production by the Peace Corps, and they approached the University of Hawaii for this purpose. Plucknett wrote a training proposal to the Peace Corps and directed this effort for three years, putting 250-300 people through two-week rice production courses, plus also treating some aspects of tropical vegetables and root crops. As the initial funding from the Peace Corps came to a close, Plucknett perceived the potential for a continuing non-degree training activity of this nature to handle around 200 people per year, but could not persuade the University or other sources to provide the front-end money--approximately $20,000--he thought it would need to take off. The remainder of the costs would have been covered by trainees' tuition. So this training center was shut down in 1970, and the facilities are not used for this purpose anymore.

That same year, 1967, CTA began to sponsor and hold some first-rate international meetings on tropical agriculture. The first Asian-Pacific Weed Science Society meeting was held at the University in 1967, and started what is now the largest regional weed professional association in the world. In 1970, an International Root Crops symposium was again held at the University, and the International Society for Tropical Root Crops was founded. One result of this latter symposium was the establishment of the justification for more research on tropical root crops, which directly led to one of CTA's two Section 406 research projects. These meetings were held with very little external support--CTA and the University were responsible. Through these means, however, CTA's experience, reputation, and eventually research support became much broader.

By 1970, however, CTA still had not really taken off in international agriculture, and in May of that year a group of nine expert consultants in tropical agriculture was assembled on the campus to explore the feasibility of adding a dimension of "International Agriculture" to the programs of the University of Hawaii and to assess CTA's aims, expertise, location, and programs in light of the challenges of agricultural problems and potential developments in tropical LDCs.[29] One of the nine consultants was

[29]"International Programs for the College of Tropical Agriculture - University of Hawaii," Report to the University of Hawaii by the Team of Consultants, May 1970, p. 1.

Dr. William Furtick, then Director of the International Plant Protection Center at Oregon State University, who was later to become Dean of CTA. According to Wilson, Dean of CTA at the time, this group of consultants helped the University very much in looking at the potential of international agriculture. The summary and recommendations of their report are listed below:

1. Hawaii has special features of soils and climate closely related to conditions in the developing countries in tropical and sub-tropical regions.

2. A number of members of the Faculty of the College of Tropical Agriculture, together with top administrators in the University, have extensive international contacts and experience, providing a firm nucleus for development of an International Tropical Agricultural Program as an added dimension to the University's activities.

3. In view of the extensive past contact with students and professional colleagues of the Asia-Pacific region, it would seem desirable for an International Tropical Agricultural Program to focus primarily on this region.

4. A number of potential projects concerned with improvement of production of a number of commodities, including horticultural crops, root crops and tropical pastures, have been suggested. Other possibilities include cooperative projects concerned with plant protection, soil management, or water management.

5. Participation in selected international programs or projects in consortium arrangements with other U.S. universities, with financial support from USAID, would provide an attractive opportunity for early activation of an international program.

6. The College of Agriculture should establish its clear identity for the International Tropical Agricultural Program and steps should be taken as soon as the program is decided upon to appoint a well qualified Director.

7. There should be close collaboration with the Food Program which is being established by the East-West Center. This relationship should retain the clear identity of the respective programs of the Center and the College, with each organization having well defined functions and areas of interest.

8. Sources of possible financial support have been proposed including USAID, the U.S. Department of Agriculture, private foundations, and international organizations.[30]

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[30] Ibid, pp. 7-8.

The award of a 211-D Grant from USAID in 1970 as part of a university consortium[31] on tropical soils was described by several people as being the key event--the real breakthrough--that put CTA on the road to international agriculture. This was the culmination of years of effort to obtain recognition from Washington of the scientific capabilities and accomplishments that had occurred at the University of Hawaii. The purpose of the 211-D Grant is to build up U.S. institutional capabilities in given scientific and technical fields of importance to LDC development, and this grant subsequently enabled CTA to get faculty involved in LDC problems and research, to grow and develop and gain further experience and knowledge. It has also served as a vehicle for identifying research needs and obtaining funding support. Out of this 211-D Grant, two further research projects were obtained by CTA from USAID: the Benchmark Soils Project in 1974 and the Biological Aspects of Nitrogen Fixation Project in 1975. (These projects are described in more detail in following sections.) Taken together, these USAID projects have been very instrumental in giving the CTA staff the experience and self-confidence required to work in international agriculture.

In 1971, at least partially as a result of the recommendations made by the group of consultants in 1970, the Office of International Agriculture Programs was established in CTA with Dr. Kenneth Otagaki as Director. The group of consultants did not want to impose a new administrative level in the bureaucracy with such an office, but to have it serve a coordinating function that would facilitate the development of international activities as an addition to ongoing CTA programs. The Director was thus to work within the Office of the Dean and to report directly to him. He/She was to be the principal representative in developing cooperative programs with the East-West Center and in providing liaison with other international activities in the University. He/She was also to work with departments in CTA to strengthen their capabilities for international activities, including curriculum development and review. Finally, he/she was to develop relationships with potential sources of financial support for CTA.[32]

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[31] Other members of the consortium included Cornell, North Carolina State, Puerto Rico, and Prairie View Universities.

[32] Ibid.,pp. 5-6.

According to Dr. Otagaki, International Agricultural Programs is responsible for the international aspects of CTA's activities. This office has coordinated proposals for research, communicated with granting agencies, and otherwise provided the administrative services necessary to promote CTA international research. Very recently, research promotion has been given even more emphasis, and two senior faculty members have been assigned to review and oversee this function.

It seems apparent that although the Office of International Agricultural Programs may coordinate and facilitate the international aspects of CTA's activities, the main focus and responsibility remains with those individuals in the departments who have contacts internationally and in Washington, and who have the interest and ambition and capabilities necessary to obtain international research funds and carry out the work. It also appears that although there were some specific examples of liaison with other parts of the University--e.g., the Nitrogen Fixation research project is being carried out jointly with the Department of Microbiology in the College of Arts and Sciences--CTA has not been involved that much with them, particularly with the East-West Center.

Undoubtedly, part of the reason for this is that a major share of the Office of International Agricultural Programs' activities appear to be devoted to a function not mentioned by the group of consultants--the programming and supervision of short-term, non-degree international training in tropical agriculture. The International Agricultural Training Program was also established in 1971, when CTA was officially designated as the sponsor of the Exchange Visitor Program by the U.S. Department of State. It is formally described as:

> A program to provide at selected locations in the State of Hawaii seminars, field training, and in-service field training in agriculture under the supervision of the University's College of Tropical Agriculture, for qualified foreign nationals of agricultural middle-management level, to promote the general interests of international exchange.[33]

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[33]"International Agricultural Training Program," August 1977, p. 1.

(The program will be described in greater detail in following sections.) Several people at CTA complained about the constant influx of visitors, both foreign and from mainland universities, who would just show up and expect an instant education in tropical agriculture. There is some indication from Dr. Wilson, Dean of CTA at the time, that this was the principal reason for the establishment of the Office of International Agricultural Programs; to handle all of these visitors.

In the early 1970's, CTA started an internal system of Task Force Research Planning. These early task forces produced results of varying quality, depending on the nature and extent of faculty involvement. Essentially, there were two weaknesses in the original system: 1) the task forces considered only research, and not research plus delivery planning; and 2) the task forces were made up almost completely of CTA faculty. More recently, the task forces have evolved into agriculture industry analysis groups, with representatives from CTA, the State of Hawaii, the Federal Government, and private industry, with CTA taking the lead role. For a description of the composition of these groups and how they operate, the quotation below is taken from the preface of the anthurium industry group report:

> As a step towards marshalling the resources available in the State of Hawaii for the development of the anthurium industry in an orderly and optimally successful fashion, representatives of the anthurium industry, interested State and County agencies, USDA, and the College of Tropical Agriculture have worked together to prepare this Industry Analysis and Action Plan which is a reasoned assessment of the industry by all those in the community that can contribute.
>
> The analysis considers all of the elements that constitute the anthurium industry. One such element is an assessment of the potential of the industry in Hawaii. Other elements are assessed in terms of this potential, bottlenecks in the achievement of the potential are identified, and requirements to relieve each bottleneck are defined. Finally, the information is summarized on a flow chart. From this base, an action plan is developed in which the units of the community best able to accept responsibility for relieving bottlenecks and the resources required are specified.
>
> To continue to reflect the current potential and bottlenecks of the industry, this analysis and action plan will need to be revised annually.[34]

[34] "Agricultural Industry Analysis: The Status, Potential, and Problems of Hawaiian Crops--Anthurium Industry Analysis," N. P. Kefford and W.T. Harada (ed.), College of Tropical Agriculture, University of Hawaii, 25 January 1978, p. 1.

For the first time in these groups, representatives from diverse groups of people with a shared interest in a State agricultural commodity are getting together. The groups are not only oriented toward research, but toward implementation and accountability. Many CTA faculty members have begun to participate in these groups, and the experience has made them more aware of the need for team action on State priorities as opposed to individual research interests. This experience has also helped to reduce faculty resistance to a proposed reorganization of CTA along programmatic lines, which is discussed in the section on CTA and the future.

One of the reasons for the success of this CTA planning effort has been the support and involvement of the State Government. The industry analysis groups are responsible to the Agricultural Coordinating Committee in the Office of the Governor, which is chaired by the Governor or his Deputy. With support from this level, the activity is taken out of the politics of inter-departmental competition, and the products of this planning have become the basis for the agricultural component of the State Development Plan. The State legislature has also participated unofficially in this planning process, and reportedly is grateful to be able to base their legislative efforts on this system rather than being subjected to the pressures of special interest groups. Thus, this recent activity has apparently been a significant factor in positively influencing the relationships between CTA and the State of Hawaii.

The CTA administration, therefore, places a great emphasis on this planning and how it has worked out in practice, and believe that there may be many lessons for LDCs in their experience--lessons that relate particularly to UNCSTD and the application of science and technology. They still are the first to say, however, that this planning process is still evolving and that there is still room for a great deal of improvement.

In 1974 and 1975, the first Section 406 funding was appropriated to CTA, but the general opinion seems to be that, although it was welcome, it really was not all that important compared to the USAID support. In addition to program planning funds, CTA was awarded a research project on Information Retrieval Systems for Tropical Research and Training Centers in the United States in 1974, and a research project on Tropical Root Crops in 1975.[35]

[35] A third Section 406 project on Tropical Soils Erosion is listed in CTA records, which was awarded in 1975, but it appears to have been so small, $90,000 over three years, that no one seems to have mentioned it.

These projects are again discussed in more detail in subsequent sections of the case study. Other Section 406 research projects were granted to the Universities of Florida and Puerto Rico, which were aimed principally at Latin America.

Finally, in 1977, Dr. William Furtick was appointed the new Dean of the College of Tropical Agriculture, and Dr. Wilson became a member of the faculty of the Department of Agriculture Economics and involved in planning activities for CTA. Future aspects of CTA are covered later.

V. Description of Major Activities of the College of Tropical Agriculture

In this section of the case study, some of the major activities of CTA referred to earlier will be described in more detail. The descriptions will be organized around the following themes: educational activities; research activities; information activities; and extension activities.

Educational Activities. The principal business of a university involves education, and, at present, the CTA has a faculty of approximately 165,[36] in 14 academic departments: Agricultural Biochemistry, Agricultural Engineering, Agricultural and Resource Economics, Agronomy and Soil Science, Animal Sciences, Botany, Entomology, Fashion Design, Food and Nutritional Sciences, Food Science and Technology, Home Economics, Horticulture, Human Development, and Plant Pathology. CTA offers a B.S. degree in Human Resource Development (departments of Human Development, Home Economics, Fashion Design, and Food and Nutritional Sciences) and in Tropical Agriculture (all the remaining departments); an M.S. degree in Agricultural Economics, Agricultural Engineering, Agronomy and Soil Science, Animal Sciences, Entomology, Food Science, Horticulture, and Nutrition; and a Ph.D. in Agricultural Economics, Agronomy and Soil Science, Entomology, and Horticulture. In 1976, CTA granted 229 B.S., 46 M.S., and 17 Ph.D. degrees. According to a breakdown of its support by activity, "teaching" accounted for $1,311,050--all from the State of Hawaii--approximately 11% of the total. Other activities listed included Research, Extension, and International Agricultural Programs.[37]

[36] The number of 165 comes from a Staff Composition and Function table filled out by the CTA as part of a Title XII land (and sea) grant university survey conducted by USAID in 1977, which concerns the rank of instructor and above. In another document--"University of Hawaii: Facilities and Capabilities for Section 406 Expansion," no date--215 faculty in academic departments and county extension programs in CTA are indicated.

[37] USAID Title XII survey, p. 2.

There were approximately 1,500 undergraduate students enrolled in CTA in the fall semester of 1977,[38] about two-thirds of these in Human Resources Development and only one-third in Tropical Agriculture. There were an additional 200 graduate students, mostly in agricultural fields. Over 100 of these students were from Asia and the Pacific (excluding Australia and New Zealand), with over 70 students from LDCs and a few more from Pacific Islands, Hong Kong, and Macao.[39] The LDCs ranged from Afghanistan to Venezuela, but most of these students (around 65%) were from Asian-Far East LDCs. One interesting fact is that most were graduate students.[40] For the University as a whole (Manoa campus), there were some 963 LDC students: 831 from Asia (excluding Japan) and another 90 from Pacific Islands (excluding Australia and New Zealand).[41] The preponderance of Asian and Pacific foreign students is explained by Hawaii's location, its ethnic heritage, and the presence of the East-West Center on campus.

CTA has always had a strong graduate education program, but recently there has been a big increase in undergraduate student enrollment, reflecting a national trend. This may be due in part to the increased interest in the environment and food production. In any event, there are proportionally fewer CTA graduate students now than there used to be, and this trend is likely to persist since the University has set a general quota for the total number of graduate students. They are concerned about the balance between graduate and undergraduate students and the cost of graduate education. What effect, if any, this will have on LDC student enrollment is not known, but most LDC students educated in foreign countries are at the graduate student level.

The division of CTA into the two academic units of agricultural sciences and human resouce development indicated above has been the cause of some concern to CTA administration, which is related to a more general concern about departmental competition as opposed to coordination. With each division being responsible to its own Assistant Dean, Human Resources Development--and much of the applied social sciences--was becoming isolated not only from the

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[38] "Facilities and Capabilities for Section 406 Expansion," p. 3.

[39] 22 November 1977, memo from Assistant Dean of CTA, Shoshuke Goto to Dean William Furtick.

[40] Ibid.

[41] USAID Title XII survey, p. 4.

agricultural departments, but also from the State Agricultural Experiment Station and extension programs. Therefore, in a reorganization move discussed in more detail in Section VII on CTA and the Future, these academic divisions have now been brought together under the coordinated curriculum and student service administration of a new Associate Dean for Academic Affairs.[42]

In addition to the formal, degree-granting educational activities of CTA, there have been non-formal, non-academic training programs on different aspects of tropical agriculture--some of which have already been mentioned. There was the short-term training center on the island of Kauai from 1967 to 1970. But, according to the Head of this center, Dr. Donald Plucknett, in order to do this type of thing well there has to be some continuity to the activity--one just cannot turn it on and off. The training that did occur from 1967 to 1970 improved markedly as it went along and they gained experience. At that time, Plucknett and others were willing to put in the necessary planning and effort--even given the small amount of original funding--because they viewed this as a long-term prospect for the University. But the University did not wish to even acknowledge the fact that non-degree training was going on under its auspices, and even small amounts of funding to keep a basic support staff going were not available from other sources, so the center was closed down. There is still a demand for this type of service, however. Recently, Dr. Plucknett was approached to train 12 people from the Philippines on tropical crop protection, on a cost reimbursable basis. It could easily have been done, but the effort to start-up would have been so time consuming that it would not have been worth it, so the offer was turned down. He could not justify taking faculty time away from their ongoing research and other activities for short-term training, no matter how valuable it might have been to the Philippines.[43]

Exactly how much non-formal, non-degree-granting training in tropical agriculture is still done in CTA under International Agricultural Programs is not known, but Dr. Otagaki estimates that in the previous year, 1976, approximately 2,500 person-days of training occurred for approximately 100

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[42] Memo from Dean William Furtick to all CTA faculty, "Phase II Reorganization and the May Conference," 27 April 1978, p. 5.

[43] It should be noted that, in a sense, continual non-degree training is also a normal function of the extension system--extension agents provide training to farmers. The training function is the same, but the clientele and organizational structure are different.

people. USDA, USAID, FAO, etc., all send people to CTA for short-term training for two weeks up to a year in various aspects of tropical agriculture. His office does the planning, logistics, coordination, and administration for these trainees on a cost-recovery basis, although full costs are not recovered. Last year, perhaps $50,000-$60,000 was charged for this activity. Both FAO and USAID send trainees through on a regular basis, and an official fee schedule has been developed to use for USAID visitors which come under a basic ordering agreement.

The International Agricultural Training Program, Exchange Visitor Program, referred to in an earlier section of this case study is a more formalized but still non-degree-granting training program also managed by CTA's Office of International Agricultural Programs. In addition to the U. S. Department of State, this program is sponsored in cooperation with local Hawaiian host farmers, the Japanese Ministry of Agriculture and Forestry, the Department of Labor of the Philippines, and some international agencies. Trainees are from 20 to 30 years old, with at least a high school or the equivalent education. They come to Hawaii and live with a host farm family for a period of one year (with a possible one-year renewal) and then return to their home country and pursue their careers in agriculture. The training consists of balanced amounts of continuing education courses, extension education, and on-the-job training in actual farm management. CTA assists in selecting host families whose participation is purely voluntary and in designing specific training programs, as well as doing program administration. How many trainees go through this program is not known at present.[44]

Research Activities. Since CTA is entirely concerned with tropical agriculture, most--if not all--of its research activities should be applicable in tropical LDCs. In this case study, however, the total research effort of CTA will be briefly outlined, and then the principal research projects directly connected with LDC interests will be described. These include the Tropical Soils Research Consortium, the Soils Benchmark Study, the Nitrogen Fixation by Tropical Agricultural Legumes, and the Tropical Root Crops projects. The CTA related sea grant research activities will also be briefly described.

By far the largest portion of CTA's current support is applied to research. Compared to the $1.3 million or 11% devoted to teaching, $6.6 million or 57% is devoted to research. Of this total, $1.6 million comes from the Federal

[44]"International Agricultural Training Program," pp. 1-6.

Government, $4.7 million from the State of Hawaii, and $0.4 million from private industry.[45] Research, like all land grant university activities, is heavily dependent upon the state for support.

Three different printouts of CTA's research projects accounting system were obtained for examination: the entire Research Program for FY77 showing project number, title, objectives, leaders, commodities, and starting and termination dates; an Appendix A to "University of Hawaii: Facilities and Capabilities for Section 406 Program Expansion" (no date), which lists projects in the same format but only those "relevant to developing countries in the tropics"; and a summary of projects and funding from State and State plus Federal sources according to subject area (mostly commodities). The first two printouts were compatible, but there was no way to relate them to the third where project numbers were not identified and, in any event, many projects appear to have qualified under more than one subject area.

In looking at CTA's research program for FY77, 193 projects are listed in total. A brief examination shows that 15 of these are devoted purely to administration; 59 are projects whose title or objectives indicate that the research is primarily aimed at the State of Hawaii; 103 are projects which concern tropical agricultural topics in general; and the remainder is questionable--8 concerned pineapple, 4 aquaculture, and 4 were very basic. In looking at these numbers, one should be aware that some of the projects oriented towards the State of Hawaii may also be applicable in LDCs. The Appendix A of CTA research relevant to developing countries lists 109 projects, largely a subset of the previous printout, but the date of this document is not known. Neither is it known what criteria were used to determine "relevance to developing countries," since the first project on this list is entitled, "Social Marginalization of Human Resources in Declining Industries in Hawaii." No dollar figures are available by project. What can be said is that over half of the CTA research projects appear to be oriented towards general topics of tropical agriculture (or to be specifically oriented towards LDCs) that would be relevant to LDCs, and that part of the remainder may also be transferable.

The best way to approach the last printout by subject area is to look at Table I which was derived from it. This table shows the range of research undertaken by CTA, as well as the relative importance given to different

[45] USAID Title XII Survey, p. 2. More recent documentation shows that the total of all research contracts and grants over $5,000 awarded directly to CTA in FY77 was just under $[illegible] million. (Memo from N. P. Kefford to W. R. Furtick, et al, "Contracts and Grants Directly to CTA," 10 April 1978.)

subject areas. Some 46 subject areas are listed, but two dominate in terms of numbers of projects and funding--Citrus and Subtropical Fruit, and Vegetables. The CTA projects in the former subject area are mainly in subtropical fruits.

As indicated earlier, the 211-D grant to the Tropical Soils Research Consortium, which includes the University of Hawaii, was originally made by USAID in 1970 and is now in its final year after being extended. During the last five years, 1974 through 1978, this grant has totalled $1,100,000 to CTA.[46] The purpose of 211-D grants is to build up U. S. institutional capacities in LDC problem areas where there is a lack of scientific and technical understanding. The receiving institutions are--in this case--expected to increase their scientific understanding of tropical soils and how they are different from temperate soils, and to gain some experience working in LDCs on identifying and solving tropical soils problems. Out of this knowledge and experience should then come an increased capacity to provide technical assistance to LDCs and USAID in this area. Faculty who are competent and who like to work and travel in LDCs will have been identified and form kind of a scientific and technical reserve for LDCs and USAID to call upon when needed. (It is estimated that about 50% of the agronomy and soils faculty would be both interested and capable to provide technical assistance to LDCs in tropical soils.)

Other aspects of the 211-D grant include developing an information system capacity to deliver information on tropical soils to LDCs and a pilot project to incorporate example material from LDCs into the basic tropical soils education curriculum at the college. There is a newsletter on tropical soils put out under the 211-D grant which has a worldwide circulation. Linkages have been created with other institutions working on tropical soils such as international agricultural research centers. In supporting specific research projects, the 211-D grant monies are used to address the current soils problems of the small farmer in tropical LDCs--e.g., the high cost of energy-intensive chemical fertilizer. The 211-D grant has thus provided CTA with an assured base of support over a number of years that it could use flexibly to build up its own capabilities without the pressures to present some specific accomplishments within given cost and time constraints. It has thus proved to be very valuable to CTA's development and evolution--the key event or breakthrough that people claim. One measure of CTA's effective use of this grant is the further tropical soils research contracts awarded to it by USAID in 1974 and 1975.

[46] USAID Title XII Survey, p. 3.

Table I. CTA Research Program by Subject Area

Subject Area	Number of Years	Total State plus Federal Funding*
Administrative Projects	5	$400,594
Soil and Land	20	$223,759
Water	11	$ 58,538
Watersheds River Basins	3	$ 25,852
Air and Climate	1	$ 12,941
Timber Forest Products	11	$110,876
Range	3	$ 49,400
Wildlife and Fish	4	$ 30,189
Citrus Subtropical Fruit	82	$1,159,725
Fruit Nuts Deciduous	23	$250,815
Pototoes	3	$ 22,011
Vegetables	71	$784,216
Ornamentals and Turf	29	$470,122
Corn	17	$201,862
Grain Sorghum	2	$ 5,444
Rice	2	$ 5,432
Pasture	3	$127,844
Forage Crops	19	$146,357
Soybeans	8	$ 55,108
Sugar Crops	16	$113,283
Miscellaneous and New Crops	5	$ 74,733
Poultry	9	$127,848
Beef Cattle	16	$284,044
Dairy Cattle	14	$171,161
Swine	7	$ 69,246
Sheep and Wool	1	$ 2,105
Other Animals	3	$ 90,458
General Purpose Supplies	3	$ 16,246
Clothing Textiles	2	$ 7,528
Food	11	$133,761
Structures Facility	8	$ 70,234
People as Individuals	11	$ 92,848
Family Members	4	$ 34,435
Farm as Business	1	$ 2,970
Social Political Organization	1	$ 120
U.S. Agriculture Economy	2	$ 16,898
Marketing Systems	3	$ 29,427
Weeds	1	$ 5,101
Biological Cell System	1	$ 16,621
Experiment Statistical Methods	1	$ 4,059
Invertabrates	6	$ 54,193
Microrganisms Virus	1	$ 7,098
Plants	3	$ 33,123
Animals Vertebrates	1	$ 6,739
Research Center Management	1	$ 4,376
Research Equipment & Technology	1	$ 3,478
		$5,613,217

*Does not include grants awarded in competitive proposal procedures.

A research project entitled, "Crop Production and Land Capabilities of a Network of Tropical Soil Families," known as the Benchmark Soils Project, was awarded to CTA by USAID in May 1974. The project is worth $1,200,000 over a period of five years from 1974 through 1979--initially a three-year contract with a two-year extension.[47] The purpose, concept, and objectives of the Benchmark Soils Project are as follows:

> The purpose of the project is to test an innovative methodology, a concept, for LDC use that will help them obtain agrotechnology for utilizing their land resources...The concept in question is: can agrotechnology be transferred from one tropical region to another tropical region on the basis of Soil Taxonomy at the soil family level of classification?...The objectives of the project are to correlate food crop yields on a network of benchmark tropical soils and to determine scientifically the transferability of agroproduction technology among tropical countries.[48]

In other words, CTA is identifying similar types of tropical soils in various locations and then attempting to find out through experimentation if an entire range of soil management-land use technology can be automatically transferred from one site to another. This would include technology/knowledge of crops and cropping systems, water management practices, erosion control measures, suitability to new crops, economics of crop production, irrigation practices, etc. The emphasis is thus on land use, on regional/national land-use planning and priorities, although efforts are also being made to affect the individual farmer.

So far, three soil families have been emphasized: volcanic ash, red soil, and acidic soil. Sites containing these soils have been identified in Hawaii, the Philippines, and Indonesia. (Similar soils have also been identified in Rwanda and the Cameroons, and the experiments may thus be extended to Africa.) Crop response data from experiments at these sites have just begun to be generated, but:

> Initial results from Hawaii and the Philippines, though very preliminary, seem to reflect very positively on the transfer hypothesis.[49]

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[47]There is some confusion here. Project personnel at CTA report that the total amount for this project is $4.3 million and that the extension has been to 1980. The above figures are from USAID Title XII Survey, p. 3.

[48]"Annual Report, 1975-1976-Benchmark Soils Project," Hawaii Agricultural Experiment Station, University of Hawaii. Report No. 3, April 1977, p. 6.

[49]Ibid., p. 5.

The project has already had a positive impact in the Philippines and Indonesia, and other LDCs have shown a great interest in being involved. Both of the above LDCs have requested that the project be extended to additional soils families which are considered to be important in their countries.

A companion project is now being carried out by the University of Puerto Rico in various sites in the Latin American tropics. One of the soil families under investigation in Puerto Rico is similar to that in Hawaii, so there is a carry-over of results. A memorandum of agreement which covers cooperative activities between the two projects was signed by both universities in January 1976, and CTA personnel have participated in developing Puerto Rico's research design and work plan.

Several other auxiliary aspects of this research project might also be briefly mentioned. A tropical soils data bank has been developed for use by LDCs. They will be able to send soil samples to the University of Hawaii and get back soil profiles, along with countries where similar soils are found, and the technology that appears to be transferable to those soil classes.[50] Some surveys of farmers' fertilizer practices have been initiated to relate to the transfer experiments. A four-week training program was held in the Philippines in May and June 1977, for participants from five LDCs on soil classification, soil surveys for assessing soil resources, and the use of the above in the transfer of agrotechnology. A training manual is now being prepared so that LDCs can conduct these courses themselves. Only one LDC graduate student at CTA is working on this project, and the remark was made in connection with this that LDCs have been slow to send students to CTA and that it is sometimes difficult to get potential LDC students to qualify under university requirements. Papers from the Benchmark Soils Project have been presented at various conferences, and in January 1976, an international seminar was held specially on "Uses of Soil Survey and Classification in Planning and Implementing Agricultural Development in the Tropics" at ICRISAT*

[50] In order to assist the LDCs in this process, the project has disseminated copies of "Soil Taxonomy," Agricultural Handbook No. 436, a basic system of soil classification to be used in soil resource inventories, and "Soil Survey Investigations Report No. 1," prepared by the USDA Soil Conservation Service, which sets forth the standard procedures necessary for the laboratory characterization of soil samples to LDCs.

* International Crops Research Institute for the Semi-Arid Tropics.

in Hydrabad, India. Some 80 soil scientists from Asia and Africa attended, and the seminar was instrumental in disseminating information on the project and in establishing a wider network for tropical soils information. Finally, a "Benchmark Soils Project Quarterly" newsletter has been created which puts out current news on what is happening with respect to the project and the different LDC network participants.

The other research project growing out of the 211-D grant on tropical soils is the Nitrogen Fixation by Tropical Agricultural Legumes project, or NIFTAL. Project funding has totaled $912,000 over three years, 1975-1978,[51] and a three-year extension has been agreed to by USAID and CTA. This project is similar to the Benchmark Soils Project in the sense that it is trying to develop a collection and classification of nitrogen-fixing bacteria which, in particular, fix nitrogen to grain legumes such as soya beans or peanuts.[52] Different bacteria are then being experimentally tested against different environmental conditions and agronomic practices to see which give the best results. Presumably, legume crops, soil types, soil bacteria, environment, and agronomy technology can then be matched in different LDCs to yield the optional production.

Most of this project is actually being carried out on the island of Maui, and this has created some administrative and coordination problems. Four faculty Ph.D.'s, one from the College of Arts and Sciences, Department of Microbiology, several technicians, and four graduate students are involved. Microbiology is an integral part of this project, and there is a tremendous scientific and technical spinoff to this field. There are also approximately 20 LDC personnel from Africa and Asia being trained under this project in research techniques--e.g., how to develop cultures, how to handle bacteria, etc. Up to this point, there has been little field work done in LDCs, but the project has been building a network of LDC collaborators and is about to go into a period when it will be testing the results that have been obtained in different LDC locations.

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[51] USAID Title XII Survey, p. 3.

[52] One of the major problems in tropical soils appears to be that the nitrogen fixing bacteria also use up the phosphorous in the soil--of which there is an inadequate amount in the first place--for themselves to the point where there is not enough for plant growth.

The research project on Tropical Root Crops Production, Processing, and Distribution has been supported by USDA under Section 406 starting in 1975. It has a duration of four years, through 1979, and a total funding of $265,000.[53] As indicated previously, this project grew out of an International Root Crop Symposium held at the university in 1970, which concluded that far too little research attention had been given to some of these significant tropical foods, particularly yams and sweet potatoes. Project objectives were stated as follows:

> The objective of this project is to lay the general background of how a food delivery system could be implemented which would import to crops of the tropics and subtropics attributes characteristic of temperate zone grains...The practical goal is to provide a method(s) of improving the food situation in LDCs by making a 10% caloric increase available to consumers.[54]

In another part of the report, the crucial phrase "with no increase in costs" is added to the latter practical goal.[55]

The grains of temperate zone crops like corn or wheat have characteristics such as high density, transportability, stability (in storage), and ease of preparation which facilitate their delivery to and use by consumers. In comparison, tropical root crops have problems with spoilage, transportation, processing, and preparation because of the high water content and high tissue matter density of roots, which make it difficult to get the starch out. This project hopes to overcome these problems through the development of knowledge and technology and the application of both engineering and economic systems modeling. The initial emphasis of the project is on taro because of its long history of growth and utilization in Hawaii. Sweet potatoes are also being studied.[56] It is important to note that under Section 406 all the research has to be done in Hawaii; it is only the results that will hopefully be transferable to and of use in LDCs.

The Tropical Root Crops project has then been divided up into three major task areas:

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[53] USAID Title XII Survey, p. 3.

[54] "A Research Program on Tropical Agriculture (Tropical Root Crops) —Annual Report for the Year Ending June 30, 1977," University of Hawaii, August 1977, p. 8.

[55] Ibid., p. 6.

[56] Research is not being done on cassava--a major tropical root crop--in this project because the majority of past root crop research has been focused on it.

- to assemble information packages on the production, economics, and delivery of food in various forms derived from taro and sweet potatoes;

- to develop and apply economic and systems models to describe the production, processing, distribution, acceptability, and consumer use of these food products; and

- to coordinate and assist specific projects in taro and sweet potato production, taro processing, the evaluation of staple root crops food farms, root crop and food protection, economic feasibility of root crop delivery systems, systems analysis and modeling of root crop production and processing, and facilitating the dissemination of the project results.[57]

Each of these project areas has objectives, accomplishments, and future plans associated with it.

Some of the accomplishments to date are that state-of-the-art reviews and bibliographies have been developed; research results indicate that various cultural practices, i.e., methods of planting, spacing of plants, fertilization, etc., can increase taro yields; drying, storage, and taste evaluations of taro have been performed; protection of taro flour against insects does not appear to be a problem; etc. Meetings have been held with the agricultural community in Hawaii to disseminate research results regarding the production and processing of taro, and a Workshop on Processing and Utilization of Tropical Root Crops is being planned for June 1978, with participants from perhaps six LDCs.

The University of Hawaii is a sea grant as well as a land grant university. The sea grant program draws heavily on the resources of CTA and in some instances--aquaculture/fish farming--is actually a part of it. The sea grant program is primarily involved in research, although it does carry out some educational activities at the graduate level and some extension activities as well.[58] The only current support shown for the program is for research--a total

[57] "Annual Report--Tropical Root Crops," pp. 8-9.

[58] A breakdown of its faculty functions shows 9.25 full-time equivalents devoted to research, 2.75 to teaching, and 1.0 to extension. No support for teaching or extension is shown, from federal, state, or other sources. The sea grant program did award three Ph.D. and four M.S. degrees in 1976, however, and three students from Asian LDCs and one from Latin America are enrolled in the program. ("USAID Title XII Sea Grant Survey," University of Hawaii, pp. 1-4.)

of $436,911, with $252,000 provided by the Federal Government, $164,911 by the State of Hawaii, and $20,000 from other sources.[59]

Research is carried out in the areas of fisheries, fish culture, marine agronomy, and the problem-oriented research projects directed toward LDCs include seed production (fish), selective breeding of aquatic food species, feed development for aquatic species, fishery stock assessment, fishery population dynamics, fishery statistical analysis, and fishery economics. Although most of their research started in the 1970's, some goes back as far as 1957-58; sponsors have included USAID, NSF, FAO, UNDP, private industry, local governments, and the sea grant program in Washington. These projects have been carried out principally in the Pacific and Southeast Asia but also some in Mexico and Madagascar. In addition to the general topics already mentioned, research has been done on river development, reef fisheries development, shrimp ranching, precious coral assessment, seaweed farming, baitfish culture, and brine shrimp culture.[60]

Information Activities. CTA's most important information activity actually comes under a Section 406 research contract from USDA entitled, "Bibliographic Retrieval System for Tropical Agricultural Commodities"; nevertheless, it has been singled out for special attention because of its innovative features in a field of much importance to the transfer of knowledge to LDCs. This project began in 1974 and runs for four years through June 1978; total funding provided was $308,000.[61] The objectives of this project were as follows:

> ...1) to analyze existing secondary coverage of tropical agricultural literature, 2) to survey the degree to which such coverage is available in machine readable form, 3) to provide specialized services such as SDI and retrospective searching from the University computer center, 4) to make recommendations for improvement of existing primary and secondary coverage, and 5) subsequently, to recommend extensions or modifications to the implemented computer search system.[62]

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[59] Ibid., p. 2.

[60] Ibid., pp. 3-6.

[61] Memo from P. Rotar to Dean Furtick, 13 June 1978.

[62] Hillary D. Burton, "Implementation and Ramifications of a Computer-Based Information System to Support Tropical Agricultural Research." Paper presented at the annual meeting of the American Society for Information Science, October 1976, p. 1.

There are generalized computerized agriculture scientific and technical information (STI) systems, of course; this is an innovational attempt to develop a specialized subset of those systems around tropical agriculture and to provide STI services relevant to this field.

The primary feature of the system was that the magnetic tapes from four major computerized agricultural or food related data bases were periodically supplied to CTA to be run through the university's computers. The data bases included those from USDA's National Agricultural Library, (CAIN--recently changed to AGRICOLA), Biological Abstracts (BA), Chemical Abstracts (CA), and Food Science and Technology Abstracts (FSTA). After some start-up assistance from USDA, the university computer center now has the capability to search these tapes on request, and they provide this service--first to university faculty and then to others.

As with many university computer centers, however, there are priorities and an excess demand for the use of available computer time, and this has curtailed some planned STI services and has meant waiting in line in some instances. Since one of the current criteria of success for STI systems is a fast turnaround time, this has been a problem of some concern. The alternative to doing it yourself, i.e., in your own computer, is to subscribe to an on-line STI service, either Lockheed or Systems Development Corporation, which are both located in California. In effect, these systems operate over 50 computerized data bases which can all be accessed through a single program--the communication between user terminal and system computer taking place over telephone lines. The CTA information project initially subscribed to this on-line service in 1974-75 but used it only for special searches where time was a critical factor because of high telecommunications costs between Hawaii and the mainland--$48 per hour. Recently, however, advances in technology have reduced these costs to $8 per hour and currently to only $6 per hour. With this reduction in cost, more use is being made of the on-line STI services. Single searches can be performed very quickly, and results are available in about three days, as compared to a week or more at the university computing center. There are several other advantages to on-line searching, including the fact that it is a time charge service that is self-supporting, except for the professional time of the accessor intermediary. Moreover, many computerized data bases are available on-line, particularly

the Commonwealth Agricultural Bureau data base which contains tropical agricultural information from many of Britain's former colonies.

In evaluating the four data bases being used at the moment,[63] the project has found that Biological Abstracts (BIOSIS) and CAIN are the two which "are essential" to the service:

> Limited indexing of CAIN and the absence of abstracts (generally) provide cause for user dissatisfaction; nevertheless, it is the backbone for agricultural information...BIOSIS results are almost always well received, even though lacking complete abstracts.[64]

The use of FSTA is limited "but directly connected with agriculture." Increasing demand for this data base in the field of aquaculture is also expected. Chemical Abstracts is the least used of the four data bases subscribed to; its present use is "minimal," and there is "little prospect" of increased use.[65]

This information service is provided to anyone doing research in tropical agriculture, regardless of affiliation or location--except that university users get first priority. An analysis of users of this information service by geographic location and by status is shown in Table II. Currently, over 300 individuals are using the service--from universities, government institutions, and private industry. Almost two-thirds of the users are from Hawaii, but the number of users from LDCs has recently begun to increase, particularly in the Philippines. This increase has been due principally to personal visits which have been made by project personnel to the University of the Philippines at Los Banos (UPLB). The principal investigator of this project, Dr. Peter Rotar, visited UPLB in April 1977, and the information specialist, Mrs. Barbara Bird, followed up with a vacation/business trip to work individually with the faculty and agricultural researchers on the use of the information service.

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[63] Experience has shown that no single or even two data bases provides comprehensive coverage of the literature for any particular subject. From 3 to 5 data bases are usually required (Burton, p. 2).

[64] "Quarterly Report Narrative for the Period Ending September 30, 1977 --Research on Information Retrieval Systems for Tropical Research and Training Center in the United States," University of Hawaii, p. 4.

[65] Ibid., p. 4.

Table II. Analysis of Users*

BY GEOGRAPHIC LOCATION		
Oahu	161	
Hawaii	18	
Kauai	6	
Maui	3	
Philippines	77	
Taiwan	9	
New Guinea	7	
Fiji	7	
Brazil	5	
Australia	3	
India	3	
New Caledonia	2	
Tonga	2	
Thailand	2	
Indonesia	1	
Puerto Rico	1	
Malaysia	1	
Bahrein	1	
California	2	
Oregon	2	(temporary location)
New York	1	
	314	
BY STATUS		
Graduate students	44	(includes 21 foreign students)
Librarians	4	
Other academics	258	
Non-academics	8	
	314	

*Source: Quarterly Report for the Period Ending September 30, 1977, p. 3.

Dr. Rotar has also visited the Asian Vegetable Research and Development Center (AVRDC) on Taiwan in connection with the project. The biggest surprise has perhaps been Brazil, where there has been no personal contact but five individuals from the organization CEPED have used the service and "appreciation is profound."[66] The project is developing a system of "major nodes" for the distribution of its information services. So far, these major nodes have been established at the South Pacific Commission (Noumea), the University of the South Pacific, the UPLB in the Philippines, and AVRDC in Taiwan.

The basic service offered to users is a Current Awareness Service, in which each user is kept apprised of the state-of-the-art according to his/her individual, special interests and needs—Selective Dissemination of Information. (As indicated earlier, retrospective search services of the literature upon individual request were originally planned in the project but have proved to be unfeasible with respect to the operations of the university computer center. Retrospective searches are, of course, available on a charge basis from the university.) What the user actually receives is a printout of current citations as references which match up with the individual's information "profile." It is important to understand that the service does not deliver the actual documents, just the citations. (Again, as originally planned, the project was to address the problem of document delivery, but this has not proven to be feasible within project resources.) Thus, the final impact of the service for LDCs depends upon the user's ability to obtain the actual documents, and this has proven to be a problem in some cases. Libraries in LDCs have only limited document collections, and even then there is often no concept of the library as an active information service; rather, the library is thought of in more traditional terms as a collector and holder of documents. Thus:

> In order to minimize postal costs while involving the libraries more closely with their respective communities, the profiles for each center are delivered to the Librarian for further distribution.[67]

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[66] Ibid., p. 2.

[67] Quarterly Report Narrative for the Period Ending June 30, 1977, p. 1.

Documents can also be obtained through inter-library loan services, and figures from the University of Hawaii's Hamilton Library, Science and Technology Division, are one indication of the effectiveness of the project. Requests for inter-library loans have increased from 365 quarterly in 1976 to 558 quarterly in 1977, almost all of this resulting from the project, according to project reports.[68] This is not necessarily a benefit for the University library staff, however, as this increase has proven to be something of a burden to them. In the future, it is hoped that telefacsimile transmission of documents would become economically feasible and help to resolve the document delivery problem.[69]

At present, this information service has been offered free to users under Section 406 project funding in order to familiarize them with it and get them to use it on a trial basis. With usage from faraway LDCs increasing at a time when this project is coming to a close, however, a cost recovery system will have to be initiated soon if the service is to continue. So far, this issue has not come up directly, but project personnel expect that the Philippines and Taiwan will at least decide to keep the service and pay for it. Soon, however, and depending on telecommunications costs, they may be running their own data base tapes through their own computer by obtaining the programming know-how from this project.

In her analysis of the project, Dr. Burton listed three problem areas in the start-up and use of the information service:

1) a scarcity of personnel with both library and computer expertise,

2) geographic dispersion of the user audience with attendant user education problems, and

3) a significant number of non-English-speaking personnel who wish to use the English language-based system.[70]

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[68] Quarterly Report, September 30, 1977, p. 2.

[69] Ibid., p. 2.

[70] Burton, abstract page.

The first problem was felt principally in the start-up phase because of the newness of the computer facilities to the University and the library staff. Project personnel recognize that there is a significant problem in dealing with users who are non-English speaking that is reflected in a difficulty to conceptualize what an information search program or search strategy is. This, in their opinion, is the principal problem in dealing with users from LDCs--they do not know what to expect from a search of computerized data bases, the right words to express what their information needs are, the peculiarities that characterize different data bases.

Several different approaches to resolving this problem have been attempted during the project. The "Current Awareness Literature Service, User's Guide,"[71] a manual developed by the USDA Agricultural Research Service for use in field locations, was tried in LDCs but did not work out well. The problem may have been the English language, but it may also have been due to the fact that this is a manual for self-help or self-use, and there may be some kind of psychological preference to depend on librarians or other information intermediaries on the part of information users. The project has now developed a simplified two-page explanation of the information service offered and a "request-for-service" form--first for use on Taiwan but later also in the Philippines. An "advertising approach" was used to design the form, according to the following parameters:

- the user would be at a remote location where, except for perhaps an initial contact with the project, there would be no one to whom he/she could turn for assistance;
- the form should enable multiple data bases to be searched;
- the user has little or no familiarity with hard-copy versions of data bases;
- the user has little knowledge of English and a low ability to identify synonyms; and
- the user considers the information professional to be both the provider of services and an authority on subject matter.[72]

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[71] USDA-ARS, "Current Awareness Literature Service, User's Guide," Beltsville, Maryland, 1974.

[72] Quarterly Report, June 30, 1977, p. 1.

This latter approach appears to have achieved much better acceptance among LDC users. Rather than not getting enough of the right kind of information about users' information needs, the project is now getting too much material, and some forms have had to be sent back so that the information requests can be further defined. At least, however, this form has elicited a positive response.

In addition to the above information service, the project has developed special, updated bibliographies on tropical agricultural commodities which are the subject of major CTA research efforts--e.g., on taro, sweet potatoes, pasture legumes and tropical legumes in general, acid soils and phosphorus availability in soils, etc. Efforts are being made to exchange information with the network of international agricultural research institutes--particularly the International Rice Research Institute (IRRI)--and to access FAO's AGRIS data base. Another aspect of the program concerns the development of a computerized file of in-house CTA information that is not put into other data bases. Finally, of course, the project provides information to CTA faculty and graduate students related to their educational and research interests.

Dr. Burton feels that the response from both the CTA information project personnel and from information service users has been encouraging and that considerable improvement has been made in tropical agricultural researchers' information use practices:

> Given the lack of widespread bibliographic computer-based services available to scientists in this broad subject area, user education requires considerable extra effort. Such education is particularly difficult to carry out without face-to-face communication which is quite often not possible. But through the combination of the user's desire to get access to the vast literature of tropical agriculture and the energetic efforts of the project personnel, considerable progress has been made....In light of the tremendous need for improved and extended technology and research in tropical agriculture food and feed production, it is hoped that programs such as this...will provide substantial contributions.[73]

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[73] Burton, p. 4.

To update CTA's LDC information activities, Information Specialist Mrs. Barbara Bird undertook a visit to several LDCs (the Philippines, Taiwan, Thailand, Kenya, Nigeria, Colombia, and Costa Rica) in February and March 1978. The purpose of this trip was as follows:

1. To explore the information needs of the programs and community of each center;

2. To view existing resources—materials, facilities, professional library skills;

3. To examine the possibility of coordination in providing agricultural information to support the needs of developing countries and especially projects dependent on U. S. funds;

4. To present to the communities of each center the capabilities of our service and special advantages for areas remote from conventional information services;

5. To discuss improvement and continuance of present SDI service as well as charge policy--AVRDC, UPLB and IITA; and

6. To assess need for:
   a. document delivery or alternative "back-up" facilities, e.g., facsimile transmission, and
   b. development of satellite communications for an agricultural information network among international centers.[74]

In the two LDCs where CTA's information service has been most active, e.g., the Philippines and Taiwan, Mrs. Bird reportedly found great enthusiasm for the service and a willingness to continue it on a partial cost charge basis. Obtaining the actual documents, however, remains a serious problem. New markets for the information services in national agricultural research and/or information centers were successfully explored in the remaining LDCs and a variety of new contacts and information flows established. In brief, CTA appears to be successfully investing in expanding the market among LDCs for their information services.

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[74] Memorandum from B. K. Bird to W. R. Furtick, "Narrative Report of International Travel," 11 May 1978.

At the same time, they are actively promoting CTA as a member of the international agricultural research center network and as a source of information services for the individual centers. On this same trip, Mrs. Bird visited the IRRI in the Philippines, the International Crops Research Institute for the Semi-Arid Tropics in India, the International Laboratory for Research on Animal Diseases and the International Center for Insect Physiology and Ecology in Kenya, the International Institute for Tropical Agriculture in Nigeria, and the International Center for Tropical Agriculture in Colombia. In addition to establishing information flows with these centers, Mrs. Bird discussed the establishment of an international telecommunications network linking them together along with five U. S. universities, including the University of Hawaii.

Mrs. Bird also visited FAO headquarters in Rome and participated in meetings and demonstrations concerning their international computerized data base for agricultural research--AGRIS. The U. S. national center for AGRIS is the USDA's National Agricultural Library (NAL), but they reportedly have not utilized the AGRIS system and apparently have no plans to do so--effectively blocking the entire U. S. from the system. Therefore, it has been recommended that if NAL does not fulfill its obligation, the CTA explore the possibility of having the AGRIS tapes delegated to it and incorporated into their information services.

A number of specific recommendations emerged from this international marketing/promotional trip, and although it is not known what will come of them, it seems evident that this innovational STI service at CTA is established and off the ground; that it is receiving support from CTA administration in its efforts to expand and market its services in LDCs; that there appears to be a great opportunity for CTA in this area; that, if combined with resources for user training and follow-up, it could provide even more valuable information services for LDCs in the future; and that information flow also provides an effective vehicle for entering into relationships with and networks of other tropical agricultural institutions.

Extension Activities. The Cooperative Extension Service is part of CTA's activities, just as it is at all land grant universities. Support for extension activities in FY75 was reported to total $2,909,432--$1,162,058

from the Federal Government and $1,747,374 from the State of Hawaii. There are 27 Cooperative Extension Service extension specialists on the CTA faculty in the various academic departments.[75] In addition, there are county extension agents on each of the State of Hawaii's four major islands--each island being considered an individual county. The extension specialists operate as full faculty members of their departments and also serve as the link to the county extension agents.

At the graduate level, there has been reasonably good cooperation among education, research, and extension functions in CTA. County extension agents have been utilized in training programs and have helped graduate students to select thesis research topics. They have also assisted many graduate students in gaining experience on research sites at actual operating farms in their counties. There is no formal program for extension education at CTA anymore. There was at one time, but it was dropped around 1965 because of a lack of student interest. Whether or not students—LDC or otherwise—receive a background or orientation in extension as part of their education varies according to department. Extension is emphasized in the Department of Agronomy and Soils, and certain courses—e.g., beginning agronomy and pastures courses--treat the subject in some detail.

There is some definite indication, however, that the extension function at CTA has not been satisfactorily integrated with the other functions —particularly research. In a memorandum on reorganization to all CTA faculty, Dean William Furtick states that there has been "inadequate coordination...independent at best and antagonistic at the worst" between extension and the state agricultural experiment station.[76] This lack of coordination has further prevented the linkage of research with client problem identification and follow up. The reorganization currently being implemented—which is discussed further in Section VII on CTA and the Future--therefore brings all research and extension programs together under a coordinated administration through the new Director of the Hawaii Institute of Tropical Agriculture and Human Resources.

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[75] USAID Title XII Land-Grant Survey, pp. 2-12.

[76] 27 April 1978, Furtick memo, p. 4.

Cooperation also does not appear to be so good between the extension and information activities discussed previously within CTA--a linkage that should be stronger because one of the functions of extension is to transmit information to farmers. However, neither the county extension agents nor the extension specialists on campus has made use of this service. Information project personnel speculate that this might be due to the perceived academic nature of the literature and the scholarly language used but argue that it is extension's job to interpret and rewrite information in a form which can be utilized by farmers.

In at least one person's opinion, the entire extension program has been a failure anyway--at least in terms of reaching the small farmers of Hawaii. The large, progressive farmers come to field days, to meetings, to see demonstrations, but the small ones do not. In his opinion, no one really knows how to reach the small, poor farmer with new technology--they seem to feel uncomfortable and out of place when confronted with it. More research is needed on how to communicate with them. This is a criticism that has been voiced about the Cooperative Extension Service in general in the United States, of course, but perhaps it is more noticeable in Hawaii where considerable numbers of small, poor farmers have continued to exist alongside the larger, more progressive ones.

This observation has some implications for LDCs, this individual believes. Land-grant universities have spent much time and effort attempting to transfer the U. S. extension system to LDCs but have failed time and again. Not only are the institutional situations different--most LDC extension functions are located in the Ministry of Agriculture rather than at universities--but the U. S. system, as indicated above, just does not know how to reach small peasant farmers. Therefore, he believes that the education and research portions of CTA's activities may fit together better for application in LDCs much more so than extension.

VI. Major Problems and Issues in the Evolution and Development of the College of Tropical Agriculture

In this section of the case study, some of the major problems and issues which have occurred in the evolution and development of CTA will be briefly discussed, along with some of their underlying reasons.

The major problem which still persists at CTA, and which was cited several times by different members of the faculty, is the fact that no comprehensive or coherent program of international activities exists--just a conglomeration of fragmented projects that have been pasted together to look like a program. (This is a situation the planning process described earlier is designed to address.) Existing research projects are not there by design of CTA but by the grace of USAID or USDA--whatever they will give, CTA has to accept in order to generate support.[77] In looking for research support, of course, CTA finds itself in direct competition with other land-grant universities. When funding for tropical agriculture research which would fit well into CTA's capabilities and plans goes, instead, to some other land-grant university, no room is left for duplication elsewhere, and so CTA is left completely out and must scramble for whatever research support is left. Then, to make things even more "frustrating"--a word that was used several times to express the intensity of CTA's feelings about this situation--individuals from some mainland land-grant universities always seem to be stopping by for a visit, to obtain a free and instant education in tropical agriculture and some legitimacy for their LDC activities. There is no doubt that CTA faculty feel strongly about this matter and also slightly helpless at being able to do anything about it. One thing that has been done is to formalize this service to visitors under the office of International Agricultural Programs, and it will not be free anymore.

There are several reasons why CTA feels at a disadvantage in competition with mainland land-grant universities for research support. The most important is location--5,000 miles away from Washington, D. C., where the action is. Travel funds provided by the university for promotional purposes are very limited, and telecommunications, although possible, are hindered by time zone

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[77] A very interesting analogy was made here to the situation in which many LDCs find themselves--rather than being able to concentrate on a comprehensive national development plan, they are continually coping with disjointed, individual foreign assistance projects from different developed countries and international agencies. Their development effort is thus fragmented, but it is very difficult to turn down the opportunities represented by foreign aid. It also does not seem to be possible to get different donor countries and agencies to work together within the framework of an overall program plan--they want individual attention.

differences and costs. A trip to Washington takes at least three to four days, and sometimes it can be difficult. In short, CTA feels isolated. In addition, CTA is a relatively young institution, compared to long-established land-grant universities such as Cornell, and does not have the experience or know-how in obtaining research funds from the Federal Government. CTA faculty do not have the contacts in Washington, in USAID and USDA, so the potential for research at CTA often goes unrecognized. The University of Hawaii does not maintain a continuous presence in Washington to perhaps keep CTA alerted as to announcements of research to be funded or research in progress in which it may have a substantial interest, and the mail takes longer to reach Hawaii.[78]

Much of this reasoning may sound like a self-serving, "sour grapes" reaction to losing research funds to other universities, but there is little doubt, as one faculty member put it, that they believe this to be probably the most important problem affecting the evolution and development of CTA. This belief is supported by cases of individual researchers in CTA who have done top-quality and very relevant work, with meaningful results, and yet have not been able to generate support in Washington. One CTA faculty member also admitted, however, that there has been a lot of inertia in CTA--a nice place to work--and a lack of purpose to go out and obtain research support.

Another major problem that has affected CTA throughout its evolution and development has been the lack of support for international activities by the State of Hawaii and the university, although this appears to have substantially changed for the better in recent years. Most of this lack of support has been felt in the form of continuing pressure from the state legislature to keep CTA research and programs relevant to the State of Hawaii, and since--as has been indicated earlier--the state is the primary funder of CTA research, the pressure has been effective. So effective has it been, in fact, that CTA really does not propose to do anything relevant to LDCs that cannot also be justified as relevant to the State of Hawaii, even in Section 406 and Title XII proposals. To be sure, there are undoubtedly many opportunities for research on tropical agriculture which have not been adequately covered and which would

[78] CTA has used the land-grant university association offices in Washington to make contacts and that sort of thing but not for assistance in any way related to obtaining research funding. There is an international programs staff person in the association, but no one knew much about it.

benefit both the state and the LDCs. Again, to be sure, justifying LDC S&T activities on a mutual self-interest basis may well turn out to be the most long-lasting way to go about it. Once more, the University of Hawaii is a state land-grant university and must fulfill its primary responsibilities to state agriculture. Yet, CTA seems to be stretching the point when it argues that research on LDC pests, which are not now problems in the state, is nevertheless justified because of the threat of their potential introduction in the future.

The same general pressure also is felt from the U. S. Congress. As can be seen from earlier discussions of the history of Section 406 and Title XII, despite the idealism expressed in isolated legislation for agriculture and food assistance to LDCs, implementation has not proceeded very quickly. Proposers are also asked to relate their activities under Section 406 to benefits to domestic agriculture.

Throughout its history, CTA appears to have had a less-than-optimal relationship with territorial and state governments. Sugar and pineapple plantations were the predominant economic force in the Islands, and each had its own association R&D facilities. The university and CTA were thus at one time even forbidden to do work in these fields, being considered somewhat peripheral to the main agricultural action. Today the situation is much different. The principal pineapple research institute has shut down, and the sugar cane research facility is reportedly in trouble. Recently, some of the plantations have also gone out of business, causing some apprehension about the agricultural economic future of the state and making CTA's research on potential new crops to replace pineapples and sugar cane look very attractive.

International activities have also become somewhat politically glamorous recently. Governor George R. Ariyoshi and his predecessor, the late John Burns, have promoted Hawaii's role of being a leader in the Asia-Pacific region in bringing peoples and cultures together--"the bridge between the U. S. and Asia," "the hub of the Pacific"--and the university was always a great part of the envisaged realization of that ambition. The presidents of the university, being appointed by the governors and closely in tune with their wishes, have also begun to provide more support for international agricultural activities. The recognition that CTA has already received in tropical

agriculture has led the university to formally commit itself to making tropical agriculture an area of excellence, and this has reportedly helped a lot. Even the state legislature has begun to provide more support, although there is still a substantial group who believes that the university should only be involved in solving Hawaii's problems.

There are still some aggravating irritations as well. Very little support is provided by the state to CTA for research program development--only $25,000 to the Department of Agronomy and Soils, which has recently brought in $3 million worth of research. At the same time, all project overhead goes into the state general fund and is not necessarily returned to the university.[79] Part of the reason for this is attributed to the fact that the university president is, in some instances, considered to be a member of the governor's cabinet. Still, things are looking much better for CTA and its international aspirations, both with respect to the state and the university.

Part of the reason for the lack of support for tropical agricultural programs in USDA in Washington is perceived to be the lack of political clout that can be applied by the small number of Hawaii's congressional delegation. Moreover, alliances with other states are also limited, because most states are in temperate climatic zones, and the initial reaction from congressmen from Nebraska and Michigan is to say that, yes, tropical agriculture is a good thing to do, but they have no personal interest in it. CTA faculty are also quick to point out that, although their congressional representation is small in numbers, they--particularly Senator Spark Matsunaga--have continually been supportive of the university and helpful to CTA.

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[79] In order to avoid such problems with the State of Hawaii, more and more CTA research programs are now being undertaken through The Research Corporation of the University of Hawaii--a mechanism that many universities have established for just this reason. The Research Corporation is described as "...a non-profit public enterprise flexibly designed to assist the university and other state agencies in promoting and implementing scientific, educational and economic development....By devising and implementing research and developmental projects directly or as joint ventures, the corporation is enabled to work readily with other governmental agencies, international organizations, foreign nations, or private businesses...." (Hawaii's Scientific Resources-1977 Directory, State of Hawaii, Department of Planning and Economic Development, 1977.)

CTA is frank to admit that they have not done a good job in interacting with the East-West Center, to exploit the opportunities of having this institution right on campus. There are some relationships, of course. As indicated earlier, the East-West Center is not a degree-granting educational institution but does send Asian-Pacific students to the University of Hawaii --many to CTA. Most East-West graduate students have appeared to graduate from the Agronomy and Soils, Animal Sciences, Agricultural Economics, and Horticulture departments. One of the center's five institutes, the Resource Systems Institute, is particularly concerned with agriculture and food production in LDCs and has major project areas that include "Increasing Productivity Under Tight Supplies of Agricultural Resources," "Pest Management," and "Aquatic Resources Management." With their limited staff, this institute does make heavy use of CTA faculty. Many of the institute staff also have part-time faculty appointments in CTA, so there is fairly good interaction at the working level but much less at higher levels.

Where CTA feels that they have really missed out, however, is in following up on East-West Center CTA alumni who have returned to their home countries. These graduates are beginning to represent a considerable amount of knowledge and experience in tropical agriculture in their home countries, and a made-to-order network of contacts for CTA to take advantage of. Moreover, the East-West Center does bring their alumni together from time to time in various ways. CTA does intend to follow up on this opportunity in the future.

One definite advantage that the East-West Center has over CTA is the resources available to operate internationally in and with LDCs. The inability of CTA to travel to and otherwise communicate with LDCs has been one of the major problems in developing their international programs. Many people cited the lack of CTA faculty firsthand experience and knowledge of LDCs, as well as a certain lack of self-confidence in being able to work there effectively, as a problem which has begun to lessen only recently. As USDA interpreted Section 406 very strictly as a domestic program to develop a U. S. capacity in tropical agriculture, travel has been largely restricted to the U. S. under this funding. Moreover, Title XII may be interpreted at the other extreme, allowing only for work in LDCs and not on campus at the University of Hawaii. So far, the USAID projects on tropical soils, benchmark soils, and nitrogen fixation have provided the only flexibility for CTA

faculty to travel and meet colleagues from the international agricultural research institutes and LDC national agricultural research institutes.

As in perhaps all colleges or programs, there are some subdivisions that do better than others. In CTA, however, the dominance of the Department of Agronomy and Soils in international activities and research in general is quite striking. The entire CTA has an annual operating budget of approximately $5 million, and the Department of Agronomy and Soils by itself brings in about $3 million in research grants and contracts. Part of this dominance may be explained by the early tradition for excellence in tropical soils, but there is more. The Section 406 project on tropical agricultural information ended up in this department, not so much because it naturally belonged there but because no other department took the initiative to obtain it. According to some faculty, some CTA departments just do not seem to be aware of the potential that they have for international work or do not seem to be able to get themselves organized to fulfill their potential.

VII. The College of Tropical Agriculture and the Future

It is perhaps obvious from the discussion of CTA's development and evolution that it does intend to become a major actor in generating and applying science and technology that will benefit the developing countries. How does it intend to go about this, and what might that future look like? It has already been mentioned that the University of Hawaii has gotten together with the University of Puerto Rico and the University of Florida in submitting a proposal to significantly expand Section 406 activities at their respective institutions, and there is also a proposal ready for a Title XII programmatic grant to establish the Hawaii Institute of Tropical Agriculture (HITA).[80] Both proposals stress three major points: 1) the rationale or need for more U. S. R&D in tropical agriculture; 2) the opportunity for Hawaii--as a state and as the University of Hawaii--to play an important role in this area; and 3) a proposed program in tropical agriculture research. Also covered in this section is a brief discussion of plans for the reorganization of CTA.

Rationale or Need. The rationale or need for more U. S. R&D in tropical agriculture is, first of all, expressed in humanitarian/political terms. The United States spends over three billion dollars each year already for

[80] "Synopsis of a Proposal for a Title XII Programmatic Grant," University of Hawaii, no date.

food and agriculture assistance to LDCs; these countries annually receive 10 million tons of food aid--much of it from the U. S. Yet, agricultural production continues to lag behind population growth and the food gap widens. It is not possible that the developed countries will be either able or willing to finance this kind of aid if present production and population trends continue. International economic tensions and explosive political situations would result to the detriment of all nations. Therefore, the development of a U. S. capacity to conduct R&D in tropical agriculture and transfer the results to LDCs should both reduce their anticipated future food deficits and enable them to make more effective use of other forms of U. S. agricultural assistance. In addition, such action is directly related to U. S. concerns for the world's poor.

The need is also expressed in manpower terms. Most of the European colonial era experts in tropical agriculture are nearing or past retirement age. At the same time, both government and private industry are increasing their involvement in LDCs and, therefore, in tropical agriculture. The U. S. is already providing some personnel as staff to the international agricultural research centers, but there is inadequate trained manpower available to backstop these overseas programs. Therefore, U. S. land-grant universities in tropical climates need to increase their education/training role in tropical agriculture.

Finally, there is a rationale related to the contribution of tropical agriculture R&D to the U. S. Many important U. S. crops such as corn and potatoes originated in the tropics, and it is important to continue importing new genetic strains for potential use in protecting against future diseases; increased tropical food production means increased supplies of those foods that the U. S. imports; much research related to tropical LDCs may be of direct use to small farmers in the U. S.; current minor crops in the U. S. will now receive more R&D attention; etc.

The Opportunity. There is an opportunity for Hawaii in this area because Hawaii is, in the United States, unique in several ways. According to the section "Hawaii is Different," the Hawaii Institute of Tropical Agriculture should be created because:

1. Hawaii is the only state in the United States located entirely in the tropics.

2. Hawaii has both large-scale plantations and processing plants (sugar and pineapple) and small-scale, diversified farms, small-scale food processors, pocket markets and island communities similar to conditions in most developing countries.

3. The University of Hawaii is both a land-grant and sea-grant institution.

4. The faculty of the College of Tropical Agriculture at the University of Hawaii, although not large in size, centers its entire research, teaching, and public service activities on food and agricultural problems of the tropics.

5. The ethnic origin of the people of Hawaii is heavily weighted to Asia and the Pacific--Polynesia, the Philippines, China and Japan.

6. The University of Hawaii has long been recognized for its degree and non-degree training programs for personnel from Asia and the Pacific Region.[81]

Moreover, Hawaii is also in a position to greatly benefit from such a development. Through the international agricultural research centers and the many national agriculture research institutes in developing countries, perhaps some $580 million is being spent on the solution of tropical agricultural problems, many of which are common to Hawaii. By placing CTA in this network and enabling it to actively participate in linking together all this R&D, Hawaii greatly augments its own R&D effort. Hawaii would become a center for the development of new tropical agricultural technology that would be applicable to local agriculture and agro-industry, giving local industry a lead-time advantage over its applications elsewhere. Major research investments from the private sector would undoubtedly also be attracted to Hawaii.[82]

Recently, there has been major support from the State of Hawaii to demonstrate their commitment to tropical agricultural research. The Board of Regents of the University of Hawaii has approved a speed-up of development plans for CTA, and nearly $25 million has been allocated for capital improvement funds needed to upgrade CTA to a status capable of effectively handling major programs in tropical agricultural research. In his state-of-the-state address

[81] Ibid., p. 2.

[82] "The Role of U. S. Agriculture in International Development," p. 59.

in January 1978, Governor George R. Ariyoshi endorsed and supported utilizing CTA as the base for a joint federal/state resource to aid food and agricultural development in the tropics of the Pacific-Asia region. The Hawaii state legislature has introduced a joint resolution in support of this concept, and major support has been expressed by the Hawaiian business community.[83]

The Proposed Program. Previous U. S. tropical agricultural research under Section 406 has resulted in an increased ability to solve certain specific problems, but there have not been enough funds to examine the larger problems of food systems. Likewise, much tropical agricultural research has been centered on specific commodities such as rice and has not addressed the numerous other problems which must be resolved to alleviate hunger and malnutrition. Therefore, CTA stresses the importance of integrated, programmatic research in tropical agriculture and proposes to build its programs around comprehensive studies of food systems and sub-systems. Such research would study all stages in food systems, from consumer back to the resources used in agricultural production, and would be multi-disciplinary in nature, enabling all aspects of the varied institutional, socio-cultural, environmental, and physical factors which are included in food systems to be addressed. In order to do this, the programs would be structured to make effective use of the wide variety of resources available in the university community.

The structure which CTA proposes has six or seven major programs at the level of food systems--basic problems that are important to sustain agriculture in the tropics: Institutional Arrangements; Technical Input Systems; Resource Management Systems; Small Farm Management Systems; Household Management Systems; and Human Nutrition, Health, and Well-Being.[84]

Institutional Arrangements include the study of socioeconomic and cultural factors in rural development, plus public policy and decision-making. As the proposal to expand Section 406 puts it:

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[83]"A Proposal to Expand...Section 406," p. 12.

[84]These are the six programs discussed in the multi-university proposal to expand Section 406, although a seventh--Nutrition--is shown on the University of Hawaii's summary budget table on p. 13. The University of Hawaii's "Synopsis of a Proposal for a Title XII Programmatic Grant" lists the above six areas plus a seventh--Food Delivery Systems. This program has elements of Food Processing and Marketing and Distribution.

> Institutional arrangement studies are necessary to effectively relate all of the program elements of a food system to each other, to the environment, and to the people to whom the specific elements have been directed.[85]

The major emphasis of the Technical Inputs Systems is to further the development of the international information storage and retrieval program in tropical agriculture to provide essential information to all other program elements. This continues the work started at CTA under previous Section 406 funding. A substantial research effort in this program will be devoted to developing improved methods of providing essential information to assist in rural development.

The Resource Management Systems program will largely concern itself with tropical soils, water management, and ecology and the environment. Increased research would be undertaken on the management of tropical soils to provide sustained yields without erosion or the loss of soil nutrients. This would lead to secondary research on plant nutrition, nitrogen fixation, and nutrient availability in tropical soils. Increased research would also be undertaken on the efficient use of water and the maintenance of water quality.

Under the Small Farm Management Systems program, a wide variety of research would be undertaken: on integrated pest management practices; on economical sources of feed for livestock; on the breeding and reproduction of livestock; on the control of livestock and poultry parasites and diseases; on the breeding, culturing, and management of tropical crops and livestock; on tropical aquaculture and fisheries. The important part of this research, however, is that it would be integrated into detailed farm management systems that relate to the total operations of both small and large farms.

The Household Management Systems program concerns those cultural factors and social values which influence household decisions regarding the choice of food, health care, shelter, etc., food preservation and preparation, and family dietary patterns. Any proposed improvements or modifications to existing food systems must contend with these forces. The effects of inadequate nutrition, coupled with the impact of debilitating tropical diseases, are

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[85] "A Proposal to Expand...Section 406," p. 9.

to be studied under the Human Nutrition, Health, and Well-Being program. The nutrition elements of this program would be carried out jointly with the National Nutrition Center at Tufts University.

Within these broad food systems programs, production program packages aimed at specific commodities would be accommodated. The University of Hawaii states its own expertise to be in the areas of tropical fruits, vegetables, root crops, livestock, forage and pasture crops, and fish and other aquacultural crops. Consortium arrangements with other U. S. universities, international agricultural research centers, and LDC agricultural research institutes would be used to supplement this expertise.

In the Title XII proposal, the University of Hawaii proposes that the Hawaii Institute of Tropical Agriculture be financed jointly by state, Title XII, and Section 406 funds--without indicating any amounts. In the proposal to expand Section 406, however, the university does propose a five-year growth in funding from approximately $6 million per year to a steady-state level of $15 million per year. They also present a first-year budget by major program areas (plus administration) and by different categories of manpower, supplies, travel, etc., the total of which is $6.021 million.[86]

In discussing this proposal and budget, CTA makes the following points:

- All proposed programs would receive some support, but the Small Farm Management Systems would receive the largest proportion of funds;
- The employment of new faculty would be minimized, but additional technical personnel would be sought and the number of graduate students greatly increased;
- There is an emphasis on travel to interchange ideas among specialists and to help in problem definition and research methodology design;
- Other aspects concerning supplies, equipment, and administration.[87]

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[86] Ibid., p. 13.

[87] Ibid., p. 14.

Reorganization of CTA. CTA has recently begun a significant reorganization which is expected to take several years to develop and implement. The essence of the reorganization is 1) a shift from a functionally separate administrative structure (teaching, research, and extension) toward the integration of these functions, and 2) from a departmental organizational basis to an interdisciplinary, programmatic organizational basis. Dean William Furtick feels that these changes are required by deficiencies in the present system and the new demands for accountability that are being made on all public institutions. He also believes that the CTA is in a unique position to make such changes and that the potential opportunities can be great:

> Our college is in a unique position to experiment with new approaches to resolve these widely perceived needs for crossing organizational boundaries because we are small enough to be able to try new approaches and, if they do not function properly, to make changes that would be difficult in some of the huge mainland universities....We are also at the juncture of perhaps the greatest period in history for changes in the roles and missions of the agricultural colleges nationally and perhaps much more markedly in our own college....[88]

What Dean Furtick has in mind is creating essentially a new College of Tropical Agriculture and Human Resources:

> This college is aimed at becoming a national and international resource center for education, research, and advisory services in tropical agriculture, human resources, and renewable natural resources, including programs dealing with tropical forestry, aquaculture, and tropical ecosystem and renewable resource planning, management and conservation.[89]

The planning process which was described earlier is part of this change. An NSF grant to experiment with how multi-disciplinary research teams work together at CTA has also provided a vehicle for change. The initial resistance of some department chairmen and many of the faculty is now lessening, and the hope is that reorganization will proceed gradually.

To summarize this section of the case study, as far as the future goes, individuals at CTA are optimistic that things are about to "take off" with respect to the State of Hawaii and to tropical agriculture in the LDCs.

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[88] Memo from Dean William Furtick to all CTA faculty, 27 April 1978, pp. 2-3.

[89] Ibid.

There appears to be more self-confidence and, at the same time, more awareness that there are real opportunities to form consortia with other land- and sea-grant universities to carry out development work in LDCs. Opportunities in the Pacific--in the Trust Territories of Micronesia, Guam, and the University of the South Pacific--are opening up. The future, in short, looks good.

VIII. Implications of the College of Tropical Agriculture Case

There are many more implications which arise from the CTA case study than can be accommodated in this brief and final section. Certainly it can be said, however, that starting up and maintaining a program for the application of science and technology in developing countries is not an easy thing to do; it is a continual effort with many failures and frustrations along the way. As always, a small group of individuals appears to lead the way, to persist in this effort--international agricultural "champions" they might be called--while the majority lags behind or is simply not interested. "Politics" has been an important ingredient to this history--at federal, state, and university levels. There do seem to be major, key events which have occurred along the way and which have greatly influenced subsequent development and evolution of the institution. Despite all the problems, success is possible.